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A
HISTORY
OF
INVENTIONS AND DISCOVERIES.

BY JOHN BECKMANN,

PUBLIC PROFESSOR OF ECONOMY IN THE UNIVERSITY OF GOTTINGEN.

TRANSLATED FROM THE GERMAN,

BY WILLIAM JOHNSTON.

SECOND EDITION,

CAREFULLY CORRECTED, AND ENLARGED BY A FOURTH VOLUME.

IN FOUR VOLUMES.

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TRANSLATOR'S PREFACE.

THAT the arts had their rise in the East, and that they were conveyed thence to the Greeks, and from them to the Romans, is universally admitted. Respecting the inventions and discoveries however of the early ages, nothing certain is known. Many of those most useful in common life must have been the production of periods when men were little acquainted with letters, or any sure mode of transmitting an account of their improvements to succeeding generations. The taste which then prevailed of giving to every thing a divine origin, rendered traditional accounts fabulous; and the exaggeration of poets tended more and more to make such authorities less worthy of credit. A variety of works also, which might have supplied us with information on this subject, have been lost; and the relations of some of those preserved are so corrupted and obscure, that the best commentators have not been able to illustrate them. This in particular is the case with many passages in Pliny, an author who appears to have collected with the utmost diligence whatever he thought useful or curious, and whose desire of communicating knowledge seems to have been equal to his thirst for acquiring it.

Of all those nations whose history has been preserved, the most distinguished are certainly the Greeks and the Romans; but, as far as can be judged at this remote period, the former were superior to the latter in point of invention. The Romans indeed seem to have known little, except what they borrowed from the Grecians; and it is evident, by their sending their young men of rank to finish their education in Greece, that they considered that country as the seat of the arts and the sciences, and as a school where genius would be excited by the finest models, while the taste was corrected and formed. From some hints given however by Pliny and other writers, we have reason to conclude that the Romans possessed more knowledge of the arts than the moderns perhaps are willing to allow, and that some inventions, considered as new, may be only old ones revived and again rendered useful.

When Rome, abandoned to luxury and vice, became an easy prey to those hordes of barbarians who overran the empire, her arts shared in the general wreck, and were either entirely lost, or for a time forgotten. The deplorable state of ignorance in which Europe was afterwards plunged during several centuries, retarded their revival; and it was not till a late period, when favoured and protected by a few men of superior genius, that they began to be again cultivated. It cannot however be denied, that several important discoveries, altogether unknown to the ancients, which must have had considerable influence on the general state of society, were made in ages that can hardly be exempted from the appellation of barbarous. As a proof of this may be mentioned the invention of paper,* painting in oil,* the mariner's compass,† gunpowder,‡ printing,§ and engraving on copper.‖ After the invention

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* Montfaucon, notwithstanding all his researches in France and Italy, was not able to discover any charter or diploma written on

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common paper, older than the year 1270. Paper, however, made of cotton, is said to be much older, and to have been introduced into Europe by the Arabs. If we can believe an Arabian author, who wrote in the thirteenth century, quoted by Casiri, in *Biblioth. Arabico-Hispana*, vol. ii. p. 9, paper (doubtless of cotton) was invented at Mecca by one Joseph Amru, about the year of the Hegira 88, or of the Christian æra 706. According to other Arabian authors, quoted by Casiri and Abulfeda, the Arabs found a manufactory of paper at Samarcand in Bucharia, when they conquered that country in the year of the Hegira 85, or of our æra 704. The art of making paper from silk was, as some pretend, known to the Chinese 180 years before Jesus Christ. See a letter from Father de Mailla to Father Etienne Souciet, in *Mémoires des inscript. et des belles lettres*, vol. xv. 520.

* The oldest picture, known at present, painted in oil-colours on wood is preserved in the Imperial gallery at Vienna. It was painted in the year 1297, by a painter named Thomas de Mutina, or de Muttersdorf, in Bohemia. Two other paintings in the same gallery are of the year 1357; one of them is by Nicholas Wurmser of Strasburg, and the other by Thierry of Prague. It appears therefore that painting in oil was known long before the epoch at which that invention is generally fixed; and that it is erroneously ascribed to Hubert van Eyck and his brother and pupil, John van Eyck, otherwise called John of Bruges, who lived about the end of the fourteenth century, and not the beginning of the fifteenth, as is commonly supposed.

† The person who first speaks of the magnetic needle and its use in navigation, is a Provençal poet, who lived in the beginning of the thirteenth century, and who wrote a poem entitled *Bible Guyot*. This work is a satire, in which the author lashes with great freedom the vices of that age. Comparing the Pope to the polar star, he introduces a description of the compass, such as it appears to have been in its infancy. This invention however is claimed by the Italians, who maintain that we are indebted for it to a citizen of

of the compass and printing, two grand sources were opened for the improvement of science. In proportion as navigation was extended, new objects were discovered to

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Amalphi, named Flavius Gioja, and in support of this assertion quote commonly the following line of Panormitanus:

Prima dedit nautis usum magnetis Amalfis.

‡ Of the use of gunpowder in Europe no certain traces occur till towards the middle of the fourteenth century. It seems pretty well proved, that artillery was known in France after the year 1345. In 1356, the city of Nuremberg purchased the first gunpowder and cannon. The same year the city of Louvain employed thirty cannon at the battle of Santfliet against the Flemings. In 1361, a fire broke out at Lubec, occasioned by the negligence of those employed in making gunpowder. In 1363, the Hanse-towns used cannon for the first time, in a naval combat which they fought against the Danes. After 1367, the use of fire-arms became general throughout Italy, into which they had been introduced from Germany.

§ The invention of printing has given rise to many researches. Meermann in his *Origines Typographicæ*, published in 1768, endeavours to prove that Laurence Coster of Harlem was the inventor, about the year 1430. Most authors however agree that John Gutenberg was the inventor of moveable types, but they differ respecting the place of the invention. Some make it to be Strasburgh, others Mentz, and some fix the epoch of the invention at 1440, and others at 1450.

|| Vasari, in *Vite de' Pittori*, vol. iv. p. 264, ascribes the invention of engraving on copper to a goldsmith of Florence, named Maso Finiguerra, about 1460. The oldest engravers whose names and marks are known, were Israel de Mecheln, of Bokholt in the bishopric of Munster; Martin Schœn, who worked at Colmar in Alsace, where he died in 1486; and Michael Wolgemuth of Nuremberg, who was preceptor to the famous Albert Durer. It may be proper here to observe, that the art of engraving on wood seems to be older than the invention of printing, to which perhaps it gave rise. The names of the first engravers on wood are however not known.

awaken the curiosity and excite the attention of the learned; and the ready means of diffusing knowledge, afforded by the press, enabled the ingenious to make them publicly known. Ignorance and superstition, the formidable enemies of philosophy in every age, began soon to lose some of that power which they had usurped; and states, forgetting their former blind policy, adopted improvements which their prejudice had before condemned.

Though it might be expected that the great share which new inventions and discoveries have at all times had in effecting such happy changes among mankind, would have secured them a distinguished place in the annals of nations; we find with regret, that the pen of history has been more employed in recording the crimes of ambition and the ravage of conquerors, than in preserving the remembrance of those who, by improving science and the arts, contributed to increase the conveniencies of life, and to heighten its enjoyments. So little indeed has hitherto been done towards a history of inventions and discoveries, that the rise and progress of part of those even of modern times is involved in considerable darkness and obscurity:* of some the names of the inventors are not so much as known, and the honour of others is disputed by different nations; while the evidences on both sides are so imperfect, that it is almost impossible to determine to which the palm is due. To professor Beckmann, therefore, those fond of such researches are much indebted for the pains he has been at to collect information on this subject; and though he has perhaps not been able to clear up every doubt respecting the objects on which he treats, he has certainly thrown much light on many curious circumstances hitherto buried in oblivion.

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* The authors who treat expressly on this subject are not numerous. We have Polydore Virgil, Pancirollus and his commentator Salmuth, D'Origny, and a few others; but the information they give is very limited and defective.

The author, with much modesty, gives to this work in the original the title of only *Collections towards a History of Inventions:* but as he has carefully traced out the rise and progress of all those objects which form the subject of his enquiry, from the earliest periods of their being known, as far as books supplied information, and arranged his matter in chronological order, the original title may admit, without being liable to much criticism, of the small variation adopted in the translation. The author, indeed, has not in these volumes comprehended every invention and discovery, but he has given an account of a great many, most of them very important; and it is not improbable that his labours in this respect may be continued. Should that be the case, and should the present work be favourably received, the rest of the original, when a sufficiency is published to form another volume, will be translated, and presented to the public in the like manner.

Should any one be disposed to find fault with the author for introducing into his work some articles which on the first view may appear trifling, his own words, taken from the short preface prefixed to the first volume of the original, will perhaps be considered as a better exculpation than any thing the translator might advance in his favour. "I am sensible," says he, "that many here will "find circumstances which they may think unworthy of "the labour I have bestowed upon them; but those who "know how different our judgments are respecting utility, "will not make theirs a rule for mine. Those whose "self-conceit would never allow them to be sensible of "this truth, and who reject as useless all ore in which "they do not observe pure gold, as they display very "little acuteness, must be often duped by the tinsel glare "of false metal; and they give me as little uneasiness as "those who have no desire to know the origin of inventions, or how they were brought to their present utility. "If my extending the term Invention farther than is perhaps usual, by comprehending under it several police-"establishments, be a fault, it is at any rate harmless, "and on that account may be pardoned without much "apology."

Germany, beyond all dispute, has given birth to more important discoveries and inventions than any other part of Europe; and gunpowder, printing, and a variety of useful machines, will remain lasting monuments of the inventive genius of the Germans. In chemistry and mechanics they seem however to have made the greatest figure, and for this a very satisfactory reason may be assigned. Germany, since the earliest periods, has been celebrated for its mines. To facilitate the labour of working these, machinery was necessary; and to extract the metal from the ore, and turn it to advantage, required a knowledge of chemical operations. Necessity is said to be the mother of invention; and it is natural to suppose that a people will always employ the efforts of their genius on those objects from which they are most likely to derive benefit.

In the history of chemical discoveries and mechanical inventions, above all, professor Beckmann has enjoyed, therefore, an advantage which might have been wanting to a writer of any other nation. It will require no great sagacity to discover, that allusion is here made to the opportunities he had of consulting many German works, little or perhaps not known in other parts of Europe, and of searching ancient annals and public records never before drawn from their obscurity to give testimony in favour of the arts. He indeed seems to have applied to every source that was likely to enrich his subject; and the voluntary contributions of learned friends enabled him to enlarge his work with much useful information, for which he expresses on several occasions his grateful acknowledgment.

The German original made its appearance in separate parts at various times; and the whole as yet published, a few small articles excepted, is now presented to the public in an English dress. The different articles in the translation are not placed exactly in the same order as in the original; but as they were arranged by the author neither alphabetically nor chronologically, this difference is of very little importance to the reader.

As the original was published in parts at different times, the author, when he found materials, gave additions to a few of the articles in some of the subsequent parts. In the translation these additions are incorporated into the articles to which they belong, and, the translator flatters himself, in such a manner as the author intended. The translator must observe also, that he has taken the liberty to abridge the original in a few places where he thought it necessary, and to give some of the text in the form of notes. The passages omitted were for the most part dry etymological researches, which could not have been well understood except by those versed in the German language; and the parts of the text now to be found among the notes, must undoubtedly appear to every reader of taste much better disposed in that manner than as they were in the original. The translator has likewise occasionally added a few notes, which, to those who read for improvement, may not appear superfluous.

A work of this nature, comprehending such a variety of scientific subjects, could not but present difficulties to the translator. The abundance of technical terms, not to be found in common dictionaries, which every where occurred, and the numerous notes and illustrations necessary to be preserved, rendered his task, indeed, both arduous and irksome. How far he has succeeded, it becomes not him to determine. He has often appeared in the same humble character before the tribunal of the public; and he has the satisfaction of reflecting, that he never found cause to be dissatisfied with the reception given to his labours. He trusts, therefore, that he shall still meet with the same indulgence, and that the present performance, if entitled to no praise, may, at least, be allowed to rank among others of the like kind which deserve no censure.

PREFACE

TO

THE SECOND EDITION.

THE first edition of this work having experienced a very favourable reception, the public are now presented with a second, carefully corrected, and enlarged by a fourth volume. The inventions which form the subject of the additional part are no less interesting than those contained in the preceding volumes; and the history of them, while it tends to throw new light on the progress of civilisation and refinement, cannot fail of affording gratification to those fond of archæological researches.

To dwell on the merit of this work is needless. Its importance has been fully established; and were farther testimony required, it might be found in the use made of it, both here and on the continent, by the compilers of dictionaries of the arts, and other publications of the same kind, who have taken copious extracts from it on different subjects, and often without any acknowledgement.* Considering, therefore, its utility; the number of inventions

* See the note, vol. iv. p. 324.

the history of which is still involved in obscurity; and the uncommon qualifications requisite in a task of this kind; it is much to be regretted that no farther continuation of it can be expected from the author, as he has now paid the last debt to nature.

The translator must again advert to the numerous difficulties which, as in the preceding parts, occurred to him while engaged on the additional volume. It was his anxious desire to avoid errors as far as possible; but he has not the vanity to suppose that his exertions have been always successful. He, however, trusts that the reader, should he find any cause for censure, will take into serious consideration the nature of the original, and the variety of the subjects on which it treats, before he proceeds to pass sentence.

HISTORY

OF

INVENTIONS.

ITALIAN BOOK-KEEPING.

THOSE who are acquainted with the Italian method of book-keeping must allow that it is an ingenious invention, of great utility to men in business, and that it has contributed to extend commerce and to facilitate its operations. It requires no less attention, care, and accuracy, than many works which are styled learned: but it is undoubtedly true, that most mercantile people, without knowing the foundation of the rules on which they proceed, conduct their books in as mechanical a manner as many of the literati do their writings.

The name, Italian book-keeping, *Doppia scrittura*, with several words employed in this branch of science and still retained in all languages, make it probable that it was invented by the Italians;

and that other nations borrowed it, as well as various short methods of reckoning, from their mercantile houses, at the time when all the East-India trade passed through Italy.

De la Porte says,* "About the year 1495, "brother Luke, an Italian, published a treatise of "it in his own language. He is the oldest author "I have seen upon the subject." Anderson, in his Historical and chronological deduction of the origin of commerce,† gives the following account: "In all probability, this art of double-"entry accounts had its rise, or at least its revival, "among the mercantile cities of Italy: possibly "it might be first known at Venice, about the time "that numeral algebra was taught there; from the "principles of which science double-entry, or "what we call merchants accounts, seems to have "been deduced. It is said that *Lucas de Burgo*, "a friar, was the first European author who "published his algebraic work at Venice, anno "1494."

This author, who was one of the greatest mathematicians of the fifteenth century, and who is supposed to be the first person who acquired a knowledge of algebra from the writings of the Arabians, was called Lucas Paciolus, e Burgo S. Sepulchri. He was a Franciscan, and so surnamed from a town

in the duchy of Urbino, on the Florentine confines, called Burgo S. Sepulchro.*

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* La science des négocians et teneurs de livres, Paris 1754. 8vo. p. 12.

† Vol. i. p. 408.

Anderson tells us,† that he had, in his possession, the oldest book published in England in which any account is given of the method of book-keeping by double-entry. It was printed at London, in 1569, in folio. The author, whose name is

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* In Scriptores ordinis Minorum, quibus accessit syllabus eorum qui, ex eodem ordine, pro fide Christi fortiter occubuerunt—Recensuit Fr. Lucas Waddingus, ejusdem instituti theologus, Romæ 1650, fol., a work reckoned by Beyer, Vogt, and others, among the very scarce books, is the following information, p. 238, respecting this author: "Lucas Paciolus e Burgo S. Sepulchri, prope fines Etruriæ, omnem pene rationem mathematicæ disciplinæ Italica lingua complexus est; conscripsit enim De divina proportione compendium; De arithmetica; De proportionibus et proportionalitatibus; opus egregium et eruditum, rudi tamen Minervâ, ad Guidobaldum Urbini ducem; De quinque corporibus regularibus; De majusculis alphabeti litteris pingendis; De corporum solidorum et vacuorum figuris, cum suis nomenclaturis. Excusa sunt Venetiis anno 1509. Transtulit Euclidem in linguam Italicam, et alia ejusdem scientiæ composuit opuscula." The same account is given in Bibliotheca Umbriæ, sive De scriptoribus Umbriæ, auctore Ludovico Jacobillo. Fulginiæ 1658. 4to. p. 180. The oldest works of this author, as mentioned in Origine e progressi della stampa, o sia dell' arte impressoria, e notizie dell' opere stampate dall' anno 1457 sino all' anno 1600. Bologna 1722. 4to.; to the dedication of which is subscribed Pellegrino Antonio Orlandi, are Fr. Lucæ de Burgo S. Sepulchri Arithmetica et geometria, Italice; characteribus Goth. Ven. 1494. fol. Liber de algebra. Ven. 1494. This is the work quoted by Anderson. Those who are desirous of further information respecting Lucas de Burgo, may consult Heilbronneri Historia matheseos universæ. Lipsiæ 1742. 4to. p. 520. Histoire des mathematiques, par M. Montucla. Paris 1758. 4to. t. i. p. 441—476. Histoire des progrès de l'esprit humain dans les sciences exactes, par Saverien. Paris 1766. 8vo. p. 18 et 38.

† Vol. i. p. 409.

James Peele, says, in his preface, that he had instructed many mercantile people in this art, which had been long practised in other countries, though in England it was then undoubtedly new. One may readily believe, that Mr. Anderson was not ignorant of the difference between the method of book-keeping by single, and that by double-entry; but he produces nothing to induce us to believe that Peele taught the latter, and not the former; for what he says of debit and credit is of no importance, as it may be applied also to the method by single-entry.

Of this Peele no mention is made in Ames' Typographical antiquities; but in that work* there is an account of a still older treatise of book-keeping, entitled *A briefe instruction and manner how to keepe bookes of accompts, after the order of debitor and creditor, and as well for proper accompts, partible, &c. by three bookes, named the memoriall, journall, and leager. Newly augmented and set forth by* John Mellis schole maister. London 1588. 12mo. Mellis, in his preface, says that he is only the re-publisher of this treatise, which was before published at London in 1543 by a schoolmaster named Hugh Oldcastle. From the above title, and particularly from the three account books mentioned in it, I am inclined to believe that this work contained the true principles of book-keeping by double-entry.

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* P. 410.

The oldest German work on book-keeping by double-entry, with which I am at present acquainted, is one written by John Gotlieb, and printed at Nuremberg, by Frederick Peypus, in 1531.* The author, in his preface, calls himself a citizen of Nuremberg, and says, that he means to give to the public a clear and intelligible method of book-keeping, such as was never before printed. It appears, therefore, that he considered his book as the first of the kind ever published in Germany.

It is worthy of remark, that even at the end of the sixteenth century, the Italian method of book-keeping began to be applied to finances and public accounts. In the works of the celebrated Simon Stevin, published at Leyden in Dutch, and the same year in Latin, we find a system of book-keeping, as applied to finances, drawn up it appears for the use of Maurice prince of Orange. To this treatise is prefixed, in Dutch and Latin, a dedication to the duke of Sully, in which the author says, that his reason for dedicating the work to Sully was, because the French had paid the greatest attention to improve the method of

keeping public accounts. The work begins with a conversation, which took place between Stevin and prince Maurice, respecting the application of book-keeping to public accounts, and in which he explains to the prince the principles of mercantile book-keeping. This conversation commences with explaining the nature of debit and credit, and the principal accounts. Then follow a short journal and ledger, in which occur only the most common transactions; and the whole concludes with an account of the other books necessary for regular book-keeping, and of the manner of balancing. Stevin expressly says, that prince Maurice, in the year 1604, caused the treasury accounts to be made out after the Italian method, by an experienced book-keeper, with the best success; but how long this regulation continued I have not been able to learn. Stevin supposes, in this system, three ministers, and three different accounts: a *quæstor*, who receives the revenues of the domains; an *acceptor*, who receives all the other revenues of the prince; and a *thesaurarius* (treasurer), who has the care of the expenditure. All inferior offices for receiving or disbursing are to send from their books monthly extracts, which are to be doubly-entered in a principal ledger; so that it may be seen at all times how much remains in the hands of each receiver, and how much each has to collect from the debtors. One cannot help admiring the inge-

nuity of the Latin translator,* who has found out, or at least invented, words to express so many new terms unknown to the ancient Romans. The learned reader may, perhaps, not be displeased with the following specimen. Book-keeping is called *apologistica* or *apologismus;* a book-keeper *apologista;* the ledger *codex accepti expensique;* the cash-book *arcarii liber;* the expense-book *impensarum liber;* the waste-book *liber deletitius;* accounts are called *nomina;* stock account *sors;* profit and loss account *lucri damnique ratiocinium, contentio* or *sortium comparatio;* the final balance *epilogismus;* the chamber of accounts, or counting-house, *logisterium,* &c.

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* The whole title runs thus: Ein Teutsh verstendig Buchhalten für herren oder gesellschafter inhalt wellischem process, des gleychen vorhin nie der jugent is fürgetragen worden, noch in drück kummen, durch Joann Gotlieb begriffen und gestelt. Darzu etlich unterricht für die jugent und andere, wie die posten so auss teglicher handlung fliessen und fürfallen, sollen im jornal nach künstlicher und buchhaltischer art gemacht, eingeschrieben und nach malss zu buch gepracht werden. Cum gratia et privilegio. Laus Deo.

In the end of this work Stevin endeavours to shew that the Romans, or rather the Grecians (for the former knew scarcely any thing but what the latter had discovered), were, in some measure, acquainted with book-keeping, and supports his conjecture by quoting Cicero's oration for Roscius. I confess that the following passage in Pliny, *Fortunæ omnia expensa, huic omnia feruntur accepta, et in tota ratione mortalium sola utramque paginam facit,*† as well as the terms *tabulæ accepti et expensi; nomina translata in tabulas,* seem to indicate that the Romans entered debit and credit in their books, on two different pages; but it appears to me not

yet proved, and improbable, that they were acquainted with our scientific method of book-keeping; with the mode of opening various accounts; of comparing them together, and of bringing them to a final balance. As bills of exchange and insurance were not known in the commerce of the ancients, the business of merchants was not so intricate and complex, as to require such a variety of books and accounts as is necessary in that of the moderns.

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* Bayle says, that the Latin translation of Stevin's works was executed principally by Willebrord Snellius.

† Lib. ii. cap. 7.

Klipstein is of opinion that attempts were made in France to apply book-keeping, by double-entry, to the public accounts, under Henry IV, afterwards under Colbert, and again in the year 1716. That attempts were made, for this purpose, under Henry IV, he concludes from a work entitled *An inquiry into the finances of France;* but I do not know whether what the author says be sufficient to support this opinion.

Those who have paid attention to the subject of finances know that, for twenty or thirty years past, mercantile book-keeping has begun to be employed at Vienna, in order to facilitate the management of public accounts, which in latter times, and in large states, have been swelled to a prodigious extent. For this improvement we are indebted to several works, some of them expensive, intended as introductions to this subject. One of these is by counsellor Puchberg, another by Mr. St. Julian, chaplain to the charity-schools,

and another by Adam Von Heidfeld.* Stevin's work before mentioned shews clearly that this improvement is not new; and seems to lessen what is said in a work published in 1777,† that count Zinzendorf was the author or patron of that excellent invention, the application of the Italian method of book-keeping by double-entry to finances and public economy.

ODOMETER.

An Odometer, Pedometer, or Waywyser, is an instrument or machine, by which the steps of a person who walks, or the revolutions made by the wheel of a carriage, can be counted; and by which the distance that one has travelled can be ascertained. Vitruvius, in his tenth book,‡ describes a machine of this kind for a carriage, and which, in his opinion, would answer for a ship. We are told by Capitolinus, in the Life of the

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56747 toises; that is, 303 toises less than Picard found it to be; or about 300 toises less than later measurements have made it. Picard himself, in his mathematical measurement, assisted by the newest improvements, erred 123 toises. It is, therefore, very surprising that Fernel should approach so near the truth with such an instrument. The manner of constructing it however, as far as I know, appears to be lost.*

Levin Hulsius, in his Treatise of mechanical instruments, published at Francfort in 1604, describes an odometer, but without naming the inventor. It appears, however, that it was the production of Paul Pfinzing, born at Nuremberg in 1554;† and who, besides other works, published, in 1598, *Methodus geometrica*, or a Treatise on measuring land, and how to use proper instruments for that purpose, on foot, on horse-

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* *In Joannis Fernelii Ambianatis Cosmotheoria*, Parisiis 1528, we find only the following passage respecting this invention—Nec vulgi supputatione satiatus, vehiculum, quod Parisios recta via petebat, conscendi, in eoque residens tota via 17024 fere rotæ circumvolutiones collegi, vallibus et montibus ad equalitatem, quoad facultas nostra ferebat, redactis. Erat autem rotæ diameter—In *Almagesti novi parte posteriori*, tomi primi, Bononiæ 1651. fol. The author, Riccioli, says, that Fernel contrived his carriage in such a manner, that the revolutions of the wheels were shewn by a hammer striking on a bell. "Preparato vero jam curru cum rota quadam, cujus revolutiones singulæ singulis tympani ictibus numerati, iter Parisiis rectum versus Boream docerent, pervenit." Where that jesuit discovered this I cannot learn.

† Doppelmayr, Nachricht von Nurnberg, künstlern, p. 82. Will, Nurnbergisches Gelehrten-Lexicon, iii. p. 156.

and that other nations borrowed it, as well as various short methods of reckoning, from their mercantile houses, at the time when all the East-India trade passed through Italy.

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* In Scriptores ordinis Minorum, quibus accessit syllabus eorum qui, ex eodem ordine, pro fide Christi fortiter occubuerunt—Recensuit Fr. Lucas Waddingus, ejusdem instituti theologus, Romæ 1650, fol., a work reckoned by Beyer, Vogt, and others, among the very scarce books, is the following information, p. 238, respecting this author: "Lucas Paciolus e Burgo S. Sepulchri, prope fines Etruriæ, omnem pene rationem mathematicæ disciplinæ Italica lingua complexus est; conscripsit enim De divina proportione compendium; De arithmetica; De proportionibus et proportionalitatibus; opus egregium et eruditum, rudi tamen Minervâ, ad Guidobaldum Urbini ducem; De quinque corporibus regularibus; De majusculis alphabeti litteris pingendis; De corporum solidorum et vacuorum figuris, cum suis nomenclaturis. Excusa sunt Venetiis anno 1509. Transtulit Euclidem in linguam Italicam, et alia ejusdem scientiæ composuit opuscula." The same account is given in Bibliotheca Umbriæ, sive De scriptoribus Umbriæ, auctore Ludovico Jacobillo. Fulginiæ 1658. 4to. p. 180. The oldest works of this author, as mentioned in Origine e progressi della stampa, o sia dell' arte impressoria, e notizie dell' opere stampate dall' anno 1457 sino all' anno 1600. Bologna 1722. 4to.; to the dedication of which is subscribed Pellegrino Antonio Orlandi, are Fr. Lucæ de Burgo S. Sepulchri Arithmetica et geometria, Italice; characteribus Goth. Ven. 1494. fol. Liber de algebra. Ven. 1494. This is the work quoted by Anderson. Those who are desirous of further information respecting Lucas de Burgo, may consult Heilbronneri Historia matheseos universæ. Lipsiæ 1742. 4to. p. 520. Histoire des mathematiques, par M. Montucla. Paris 1758. 4to. t. i. p. 441—476. Histoire des progrès de l'esprit humain dans les sciences exactes, par Saverien. Paris 1766. 8vo. p. 18 et 38.

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James Peele, says, in his preface, that he had instructed many mercantile people in this art, which had been long practised in other countries, though in England it was then undoubtedly new. One may readily believe, that Mr. Anderson was not ignorant of the difference between the method of book-keeping by single, and that by double-entry; but he produces nothing to induce us to believe that Peele taught the latter, and not the former; for what he says of debit and credit is of no importance, as it may be applied also to the method by single-entry.

Of this Peele no mention is made in Ames' Typographical antiquities; but in that work* there is an account of a still older treatise of book-keeping, entitled *A briefe instruction and manner how to keepe bookes of accompts, after the order of debitor and creditor, and as well for proper accompts, partible, &c. by three bookes, named the memoriall, journall, and leager. Newly augmented and set forth by* John Mellis schole maister. London 1588. 12mo. Mellis, in his preface, says that he is only the re-publisher of this treatise, which was before published at London in 1543 by a schoolmaster named Hugh Oldcastle. From the above title, and particularly from the three account books mentioned in it, I am inclined to believe that this work contained the true principles of book-keeping by double-entry.

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It is worthy of remark, that even at the end of the sixteenth century, the Italian method of book-keeping began to be applied to finances and public accounts. In the works of the celebrated Simon Stevin, published at Leyden in Dutch, and the same year in Latin, we find a system of book-keeping, as applied to finances, drawn up it appears for the use of Maurice prince of Orange. To this treatise is prefixed, in Dutch and Latin, a dedication to the duke of Sully, in which the author says, that his reason for dedicating the work to Sully was, because the French had paid the greatest attention to improve the method of

keeping public accounts. The work begins with a conversation, which took place between Stevin and prince Maurice, respecting the application of book-keeping to public accounts, and in which he explains to the prince the principles of mercantile book-keeping. This conversation commences with explaining the nature of debit and credit, and the principal accounts. Then follow a short journal and ledger, in which occur only the most common transactions; and the whole concludes with an account of the other books necessary for regular book-keeping, and of the manner of balancing. Stevin expressly says, that prince Maurice, in the year 1604, caused the treasury accounts to be made out after the Italian method, by an experienced book-keeper, with the best success; but how long this regulation continued I have not been able to learn. Stevin supposes, in this system, three ministers, and three different accounts: a *quæstor*, who receives the revenues of the domains; an *acceptor*, who receives all the other revenues of the prince; and a *thesaurarius* (treasurer), who has the care of the expenditure. All inferior offices for receiving or disbursing are to send from their books monthly extracts, which are to be doubly-entered in a principal ledger; so that it may be seen at all times how much remains in the hands of each receiver, and how much each has to collect from the debtors. One cannot help admiring the inge-

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the history of which is still involved in obscurity; and the uncommon qualifications requisite in a task of this kind; it is much to be regretted that no farther continuation of it can be expected from the author, as he has now paid the last debt to nature.

The translator must again advert to the numerous difficulties which, as in the preceding parts, occurred to him while engaged on the additional volume. It was his anxious desire to avoid errors as far as possible; but he has not the vanity to suppose that his exertions have been always successful. He, however, trusts that the reader, should he find any cause for censure, will take into serious consideration the nature of the original, and the variety of the subjects on which it treats, before he proceeds to pass sentence.

America, but complains of the negligence with which it was practised. In a passage, however, in the Vienna edition, and which has probably been added by Gobet, we are told that, in the year 1609, Barba attempted to fix quicksilver, and with that view bethought himself of mixing it with fine pounded silver ore; that he at first imagined, with surprise, that he had obtained a mass of silver, but that he soon perceived that the mercury was not changed into silver, but had only attracted the particles of that metal. "I was," adds Barba, "highly pleased with my new discovery of managing ore, of extracting its contents, and of "refining it; and this method I continued to practise."—I imagine that Barba was still in Europe in 1609, and made that experiment before he was acquainted with the smelting-works in America. I am, however, of opinion, that one will see by the original, that Barba did not wish to claim the invention of amalgamation as practised in the mines of America.

DRY GILDING.

Dry gilding, as it is called by some workmen, is a light method of gilding, by steeping linen rags in a solution of gold, then burning them; and, with a piece of cloth dipped in salt-water, rubbing

and that other nations borrowed it, as well as various short methods of reckoning, from their mercantile houses, at the time when all the East-India trade passed through Italy.

De la Porte says,* "About the year 1495, "brother Luke, an Italian, published a treatise of "it in his own language. He is the oldest author "I have seen upon the subject." Anderson, in his Historical and chronological deduction of the origin of commerce,† gives the following account: "In all probability, this art of double-"entry accounts had its rise, or at least its revival, "among the mercantile cities of Italy: possibly "it might be first known at Venice, about the time "that numeral algebra was taught there; from the "principles of which science double-entry, or "what we call merchants accounts, seems to have "been deduced. It is said that *Lucas de Burgo*, "a friar, was the first European author who "published his algebraic work at Venice, anno "1494."

This author, who was one of the greatest mathematicians of the fifteenth century, and who is supposed to be the first person who acquired a knowledge of algebra from the writings of the Arabians, was called Lucas Paciolus, e Burgo S. Sepulchri. He was a Franciscan, and so surnamed from a town

in the duchy of Urbino, on the Florentine confines, called Burgo S. Sepulchro.*

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* La science des négocians et teneurs de livres, Paris 1754. 8vo. p. 12.

† Vol. i. p. 208.

Anderson tells us,† that he had, in his possession, the oldest book published in England in which any account is given of the method of book-keeping by double-entry. It was printed at London, in 1569, in folio. The author, whose name is the English, but to the Italians, and properly to the Sicilians. Antonino Cento, an artist of Palermo, found out the gold varnish, and in the year 1680 published there an account of the method of preparing it. That work I have never seen; but I found this information in a book printed at Palermo in 1704, and entitled The Inventions of the Sicilians.* Among the few important things contained in this book, the greater part of which is compiled from old Latin writers, there is, in the additions, a receipt how to prepare the gold varnish *(vernice d'oro).* The whole account I shall transcribe, as the authors of the French Journal of agriculture, commerce, and the arts, thought it worth their trouble to make it known in that work in 1778.

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* In Scriptores ordinis Minorum, quibus accessit syllabus eorum qui, ex eodem ordine, pro fide Christi fortiter occubuerunt—Recensuit Fr. Lucas Waddingus, ejusdem instituti theologus, Romæ 1650, fol., a work reckoned by Beyer, Vogt, and others, among the very scarce books, is the following information, p. 238, respecting this author: "Lucas Paciolus e Burgo S. Sepulchri, prope fines Etruriæ, omnem pene rationem mathematicæ disciplinæ Italica lingua complexus est; conscripsit enim De divina proportione compendium; De arithmetica; De proportionibus et proportionalitatibus; opus egregium et eruditum, rudi tamen Minervâ, ad Guidobaldum Urbini ducem; De quinque corporibus regularibus; De majusculis alphabeti litteris pingendis; De corporum solidorum et vacuorum figuris, cum suis nomenclaturis. Excusa sunt Venetiis anno 1509. Transtulit Euclidem in linguam Italicam, et alia ejusdem scientiæ composuit opuscula." The same account is given in Bibliotheca Umbriæ, sive De scriptoribus Umbriæ, auctore Ludovico Jacobillo. Fulginiæ 1658. 4to. p. 180. The oldest works of this author, as mentioned in Origine e progressi della stampa, o sia dell' arte impressoria, e notizie dell' opere stampate dall' anno 1457 sino all' anno 1600. Bologna 1722. 4to.; to the dedication of which is subscribed Pellegrino Antonio Orlandi, are Fr. Lucæ de Burgo S. Sepulchri Arithmetica et geometria, Italice; characteribus Goth. Ven. 1494. fol. Liber de algebra. Ven. 1494. This is the work quoted by Anderson. Those who are desirous of further information respecting Lucas de Burgo, may consult Heilbronneri Historia matheseos universæ. Lipsiæ 1742. 4to. p. 520. Histoire des mathematiques, par M. Montucla. Paris 1758. 4to. t. i. p. 441—476. Histoire des progrès de l'esprit humain dans les sciences exactes, par Saverien. Paris 1766. 8vo. p. 18 et 38.

† Vol. i. p. 409.

"Take gum lac, and having freed it from the filth and bits of wood with which it is mixed, put it into a small linen bag, and wash it in pure water, till the water no longer becomes red; then take it from the bag and suffer it to dry. When it is perfectly dry, pound it very fine; because the finer it is pounded it will dissolve the more readily. Then take four parts of spirit of wine, and one of the gum, reduced as before directed, to an impalpable powder, so that for every four pounds of

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* La Sicilia inventrice; overo, Le invenzione lodevoli nate in Sicilia, opera del Dottor. D. Vincenzo Auria, Palermitano: con li divertimenti geniali, osservazioni e giunte all' istessa, di D. Antonio Mongitore, sacerdote Palermitano. In Palermo 1704. 300 pages in quarto.

The oldest German work on book-keeping by double-entry, with which I am at present acquainted, is one written by John Gotlieb, and printed at Nuremberg, by Frederick Peypus, in 1531.[*] The author, in his preface, calls himself a citizen of Nuremberg, and says, that he means to give to the public a clear and intelligible method of book-keeping, such as was never before printed. It appears, therefore, that he considered his book as the first of the kind ever published in Germany.

It is worthy of remark, that even at the end of the sixteenth century, the Italian method of book-keeping began to be applied to finances and public accounts. In the works of the celebrated Simon Stevin, published at Leyden in Dutch, and the same year in Latin, we find a system of book-keeping, as applied to finances, drawn up it appears for the use of Maurice prince of Orange. To this treatise is prefixed, in Dutch and Latin, a dedication to the duke of Sully, in which the author says, that his reason for dedicating the work to Sully was, because the French had paid the greatest attention to improve the method of

keeping public accounts. The work begins with a conversation, which took place between Stevin and prince Maurice, respecting the application of book-keeping to public accounts, and in which he explains to the prince the principles of mercantile book-keeping. This conversation commences with explaining the nature of debit and credit, and the principal accounts. Then follow a short journal and ledger, in which occur only the most common transactions; and the whole concludes with an account of the other books necessary for regular book-keeping, and of the manner of balancing. Stevin expressly says, that prince Maurice, in the year 1604, caused the treasury accounts to be made out after the Italian method, by an experienced book-keeper, with the best success; but how long this regulation continued I have not been able to learn. Stevin supposes, in this system, three ministers, and three different accounts: a *quæstor*, who receives the revenues of the domains; an *acceptor*, who receives all the other revenues of the prince; and a *thesaurarius* (treasurer), who has the care of the expenditure. All inferior offices for receiving or disbursing are to send from their books monthly extracts, which are to be doubly-entered in a principal ledger; so that it may be seen at all times how much remains in the hands of each receiver, and how much each has to collect from the debtors. One cannot help admiring the inge-

nuity of the Latin translator,* who has found out, or at least invented, words to express so many new terms unknown to the ancient Romans. The learned reader may, perhaps, not be displeased with the following specimen. Book-keeping is called *apologistica* or *apologismus;* a book-keeper *apologista;* the ledger *codex accepti expensique;* the cash-book *arcarii liber;* the expense-book *impensarum liber;* the waste-book *liber deletitius;* accounts are called *nomina;* stock account *sors;* profit and loss account *lucri damnique ratiocinium, contentio* or *sortium comparatio;* the final balance *epilogismus;* the chamber of accounts, or counting-house, *logisterium,* &c.

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[*] The whole title runs thus: Ein Teutsh verstendig Buchhalten für herren oder gesellschafter inhalt wellischem process, des gleychen vorhin nie der jugent is fürgetragen worden, noch in drück kummen, durch Joann Gotlieb begriffen und gestelt. Darzu etlich unterricht für die jugent und andere, wie die posten so auss teglicher handlung fliessen und fürfallen, sollen im jornal nach künstlicher und buchhaltischer art gemacht, eingeschrieben und nach malss zu buch gepracht werden. Cum gratia et privilegio. Laus Deo.

In the end of this work Stevin endeavours to shew that the Romans, or rather the Grecians (for the former knew scarcely any thing but what the latter had discovered), were, in some measure, acquainted with book-keeping, and supports his conjecture by quoting Cicero's oration for Roscius. I confess that the following passage in Pliny, *Fortunæ omnia expensa, huic omnia feruntur accepta, et in tota ratione mortalium sola utramque paginam facit,*† as well as the terms *tabulæ accepti et expensi; nomina translata in tabulas,* seem to indicate that the Romans entered debit and credit in their books, on two different pages; but it appears to me not

yet proved, and improbable, that they were acquainted with our scientific method of book-keeping; with the mode of opening various accounts; of comparing them together, and of bringing them to a final balance. As bills of exchange and insurance were not known in the commerce of the ancients, the business of merchants was not so intricate and complex, as to require such a variety of books and accounts as is necessary in that of the moderns.

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* Bayle says, that the Latin translation of Stevin's works was executed principally by Willebrord Snellius.

† Lib. ii. cap. 7.

Klipstein is of opinion that attempts were made in France to apply book-keeping, by double-entry, to the public accounts, under Henry IV, afterwards under Colbert, and again in the year 1716. That attempts were made, for this purpose, under Henry IV, he concludes from a work entitled *An inquiry into the finances of France;* but I do not know whether what the author says be sufficient to support this opinion.

Those who have paid attention to the subject of finances know that, for twenty or thirty years past, mercantile book-keeping has begun to be employed at Vienna, in order to facilitate the management of public accounts, which in latter times, and in large states, have been swelled to a prodigious extent. For this improvement we are indebted to several works, some of them expensive, intended as introductions to this subject. One of these is by counsellor Puchberg, another by Mr. St. Julian, chaplain to the charity-schools,

and another by Adam Von Heidfeld.* Stevin's work before mentioned shews clearly that this improvement is not new; and seems to lessen what is said in a work published in 1777,† that count Zinzendorf was the author or patron of that excellent invention, the application of the Italian method of book-keeping by double-entry to finances and public economy.

ODOMETER.

An Odometer, Pedometer, or Waywyser, is an instrument or machine, by which the steps of a person who walks, or the revolutions made by the wheel of a carriage, can be counted; and by which the distance that one has travelled can be ascertained. Vitruvius, in his tenth book,‡ describes a machine of this kind for a carriage, and which, in his opinion, would answer for a ship. We are told by Capitolinus, in the Life of the

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* A short account of this improvement, and the writings it gave rise to, may be found in *Klipstein, Grundsatze der wissenschaft rechnungen einzurichten.* Leipzig 1778. 8vo. and also in another work, by the same author, entitled *Grundsatze der rechnungswissenschaft auf das privatermogen angewendet.* Wien 1774. fol.

† Denkwurdigkeiten von Wien 1777. 8vo. p. 210.

‡ C. 14. Nicolai, in the first part of his Travels, has translated this description of an odometer, and illustrated it with a figure by H. Catel. Explanations of the above-mentioned passage of Vitruvius, which throw little light on the subject, may be found in various editions of that author, such as that by Gualterus H. Rivius Medic. et Mathem. Basiliæ 1575. fol.

Balbinus asserts, that Busbeque brought the first tulip-roots to Prague, from which they were afterwards spread all over Germany.* This is not improbable; for Busbeque says, in a letter written in 1554, that this flower was then new to him; and it is known that besides coins and manuscripts he collected also natural curiosities, and brought with him from the Levant. Nay, he tells us that he paid very dear to the Turks for these tulips; but I do not find he any where says that he was the first who brought them from the east.

In the year 1565 there were tulips in the garden of Mr. Fugger, from whom Gesner wished to procure some.† They first appeared in Provence, in France, in the garden of the celebrated Peyresc, in the year 1611.‡

After the tulip was known, Dutch merchants, and rich people at Vienna, who were fond of flowers, sent, at different times, to Constantinople for various kinds. The first roots planted in England were sent thither from Vienna, about the end of the sixteenth century, according to Hakluyt;§

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* Balbini Miscellanea Bohemiæ, p. 100.

† Gesneri Epistolæ mediciuales. Tiguri 1577. 8vo. p. 79 and 80.

‡ Vita Peirescii, auctore Gassendo. Hagæ Comitum 1655. 4to. p. 80.

§ Hakluyt says, And now within these four years, there have been brought into England from Vienna in Austria, divers kind of flowers called tulipas, and those and others procured thither a little before, from Constantinople, by an excellent man, M. Carolus Clusius. See *Biographia Britannica*, ii. p. 164.

who is, however, wrong in ascribing to Clusius the honour of having first introduced them into Europe; for that naturalist only collected and described all the then known species.

These flowers, which are of no farther use than to ornament gardens; which are exceeded in beauty by many other plants, and whose duration is short, and very precarious, became, in the middle of the 17th century, the object of a trade such as is not to be met with in the history of commerce, and by which their price rose above that of the most precious metals. An account of this trade has been given by many authors; but by all late ones it has been misrepresented. People laugh at the Tulipomania,* because they believe that the beauty and rarity of the flowers induced florists to give such extravagant prices: they imagine that the tulips were purchased so excessively dear in order to ornament gardens; but this supposition is false, as I shall show hereafter.

This trade was not carried on throughout all Europe, but in some cities of the Netherlands, particularly Amsterdam, Harlem, Utrecht, Alkmar, Leyden, Rotterdam, Hoorn, Enkhuysen, and Meedenblick; and rose to the greatest height in the years 1634,-35,-36, and -37.† Munting has given, from some of the books kept during that trade, a few of the prices then paid; of which I shall present the reader with the following. For a root of that species called the Viceroy the aftermentioned articles, valued as below expressed, were agreed to be delivered.

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* This word was coined by Menage.

† The principal works in which an account of this Tulipomania is to be found are: *Eerste tzamenspraak tuschen Waermondt en Gaargoed nopens de opkomst en ondergang van Flora.* Amsterdam 1643.

	florins
2 lasts of wheat	448
4 ditto rye	558
4 fat oxen	480
8 fat swine	240
12 fat sheep	120
2 hogsheads of wine	70
4 tons beer	32
2 ditto butter	192
1000 pounds of cheese	120
a complete bed	100
a suit of clothes	80
a silver beaker	60
Sum	2500

12mo. *Meterani novi* or New History of the Netherlands, part fourth. Amst. 1640. folio. p. 518. from which Marquard, *De jure mercatorum*, p. 181, has taken his information. *Nauwkeurige beschryving der aardgewassen, door* Abraham Munting. Leyden en Utrecht 1696. folio. p. 907. *De Koophandel von Amsterdam,* door Le Long, ii. p. 307. *Le Negoce d'Amsterdam,* par J. P. Ricard. A Rouen 1723. 4to. p. 11. *Breslauer, Samlung von Natur-und Kunst-Geschichten,* 1721, May, p. 521. *Francisci Schaubuhne,* vol. ii. p. 639. *Tenzel, Mondtliche Unterredungen,* 1690, Novemb. p. 1039. *Année Literaire,* 1773, xv. p. 16. *Martini Zeiler Miscellanea,* p. 29. *Christ. Funcii Orbis politicus,* p. 879.

These tulips afterwards were sold according to the weight of the roots. Four hundred perits* of Admiral Leifken cost 4400 florins; 446 ditto of Admiral Von der Eyk, 1620 florins; 106 perits Schilder cost 1615 florins; 200 ditto Semper Augustus, 5500 florins; 410 ditto Viceroy, 3000 florins, &c. The species Semper Augustus has been often sold for 2000 florins; and it once happened, that there were only two roots of it to be had, the one at Amsterdam and the other at Harlem. For a root of this species, one agreed to give 4600 florins, together with a new carriage, two grey horses, and a complete harness. Another agreed to give for a root twelve acres of land: for those who had not ready money, promised their moveable and unmoveable goods, houses and lands, cattle and clothes. A man, whose name Munting once knew, but could not recollect, won by this trade more than 60,000 florins in the course of four months. It was followed not only by mercantile people, but also by the first noblemen, citizens of every description, mechanics, seamen, farmers, turf-diggers, chimney-sweeps, footmen, maid-servants, and old-clothes-women, &c. At first, every one won and no one lost. Some of the poorest people gained in a few months houses, coaches and horses, and figured away like the first characters in the land. In every town some tavern was selected which served as a change, where high and low traded in flowers, and confirmed their bargains with the most sumptuous entertainments. They formed laws for themselves, and had their notaries and clerks.

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* A perit is a small weight less than a grain. TRANS.

When the nature of this trade is considered, it will readily be perceived, that to get possession of these flowers was not the real object of it, though many have represented it in that light. The price of tulips rose always higher from the year 1634 to the year 1637; but had the object of the purchaser been to get possession of the flowers, the price in such a length of time must have fallen instead of risen. " Raise the prices of the pro-
" ductions of agriculture, when you wish to reduce
" them, "says Young; and in this he is undoubtedly right, for a great consumption causes a greater reproduction. This has been sufficiently proved by the price of asparagus at Göttingen. As it was much sought after, and large prices paid for it, more of it was planted, and the price has fallen. In like manner plantations of tulips would have in a short time been formed in Holland, and florists would have been able to purchase flowers at a much lower price. But this was not done; and the chimney-sweeper, who threw aside his besom, did not become a gardener, though he was a dealer in flowers. Roots would have been imported from distant countries, as asparagus was from Hanover and Brunswick to Göttingen; the

high price would have induced people to go to Constantinople to purchase roots, as the Europeans travel to Golconda and Visapour to procure precious stones: but the dealers in tulips confined themselves to their own country, without thinking of long journeys. I will allow that a flower might have become scarce, and consequently dearer; but it would have been impossible for the price to rise to a great height, and continue so for a year. How ridiculous would it have been to purchase useless roots with their weight of gold, if the possession of the flower had been the only object! Great is the folly of mankind; but they are not fools without a cause, as they would have been under such circumstances.

During the time of the Tulipomania, a speculator often offered and paid large sums for a root which he never received, and never wished to receive. Another sold roots which he never possessed or delivered. Oft did a nobleman purchase of a chimney-sweep tulips to the amount of 2000 florins, and sell them at the same time to a farmer; and neither the nobleman, chimney-sweep, or farmer had roots in their possession, or wished to possess them. Before the tulip season was over, more roots were sold and purchased, bespoke, and promised to be delivered, than in all probability were to be found in the gardens of Holland; and when Semper Augustus was not to be had, which happened twice, no species perhaps was oftener purchased and sold. In the space of three years, as Munting tells us, more than ten millions were expended in this trade, in only one town of Holland.

To understand this gambling traffic, it may be necessary to make the following supposition. A nobleman bespoke of a merchant a tulip-root, to be delivered in six months, at the price of 1000 florins. During these six months the price of that species of tulip must have risen or fallen, or remained as it was. We shall suppose, that at the expiration of that time the price was 1500 florins; in that case, the nobleman did not wish to have the tulip, and the merchant paid him 500 florins, which the latter lost and the former won. If the price was fallen when the six months were expired, so that a root could be purchased for 800 florins, the nobleman then paid to the merchant 200 florins, which he received as so much gain; but if the price continued the same, that is 1000 florins, neither party gained or lost. In all these circumstances, however, no one ever thought of delivering the roots or of receiving them. Henry Munting, in 1636, sold to a merchant at Alkmar, a tulip-root for 7000 florins, to be delivered in six months; but as the price during that time had fallen, the merchant paid, according to agreement, only ten per cent. "So that my father," says the son, "received 700 florins for nothing; "but he would much rather have delivered the root "itself for 7000." The term of these contracts was often much shorter, and on that account the trade became brisker. In proportion as more gained by this traffic, more engaged in it; and those who had money to pay to one, had soon money to receive of another; as at faro, one loses upon one card, and at the same time wins on another. The tulip-dealers often discounted sums also, and transferred their debts to one another; so that large sums were paid without cash, without bills, and without goods, as by the *Virements* at Lyons. The whole of this trade was a game at hazard, as the Missisippi trade was afterwards, and as stock-jobbing is at present. The only difference between the tulip-trade and stock-jobbing is, that at the end of the contract the price in the latter is determined by the Stock-exchange; whereas in the former it was determined by that at which most bargains were made. High- and low-priced kinds of tulips were procured, in order that both the rich and the poor might gamble with them; and the roots were weighed by perits, that an imagined whole might be divided, and that people might not only have whole, but half and quarter lots. Whoever is surprised that such a traffic should become general, needs only to reflect upon what is done where lotteries are established, by which trades are often neglected, and even abandoned, because a speedier mode of getting [fortunes is pointed out to the lower classes. In short, the tulip-trade may very well serve to explain stock-jobbing, of which so much is written in gazettes, and of which so many talk in company without understanding it; and I hope on that account, I shall be forgiven for employing so much time in illustrating what I should otherwise have considered as below my notice.

At length, however, this trade fell all of a sudden. Among such a number of contracts many were broken; many had engaged to pay more than they were able; the whole stock of the adventurers was consumed by the extravagance of the winners; new adventurers no more engaged in it; and many becoming sensible of the odious traffic in which they had been concerned, returned to their former occupations. By these means, as the value of tulips still fell, and never rose, the sellers wished to deliver the roots *in natura* to the purchasers at the prices agreed on; but as the latter had no desire for tulips at even such a low rate, they refused to take them or to pay for them. To end this dispute, the tulip-dealers of Alkmar sent in the year 1637 deputies to Amsterdam; and a resolution was passed on the 24th of February, that all contracts made prior to the last of November 1636 should be null and void; and that, in those made after that date, purchasers should be free on paying ten per cent. to the vender.

The more people became disgusted with this trade, the more did complaints increase to the magistrates of the different towns; but as the courts there would take no cognizance of it, the complainants applied to the States of Holland and West Friesland. These referred the business to the determination of the provincial council at the Hague, which on the 27th of April 1637 declared, that it would not deliver its opinion on this traffic until it had received more information on the subject; that in the mean time every vender should offer his tulips to the purchaser; and, in case he refused to receive them, the vender should either keep them, or sell them to another, and have recourse on the purchaser for any loss he might sustain. It was ordered also, that all contracts should remain in force till further inquiry was made. But as no one could foresee what judgment would be given respecting the validity of each contract, the buyers were more obstinate in refusing payment than before; and venders, thinking it much safer to accommodate matters amicably, were at length satisfied with a small profit instead of exorbitant gain: and thus ended this extraordinary traffic, or rather gambling.

It is however certain, that persons fond of flowers, particularly in Holland, have paid, and still pay, very high prices for tulips, as the catalogues of florists show.* This may be called the lesser Tulipomania, which has given occasion to many laughable circumstances. When John Balthasar Schuppe was in Holland, a merchant gave a herring to a sailor who had brought him some goods. The sailor, seeing some valuable tulip-roots lying about, which he considered as of little consequence, thinking them to be onions, took some of them unperceived, and ate them with his herring. Through this mistake the sailor's breakfast cost the merchant a much greater sum than if he had treated the Prince of Orange. No less laughable is the anecdote of an Englishman who travelled with Matthews. Being in a Dutchman's garden, he pulled a couple of tulips, on which he wished to make some botanical observations, and put them in his pocket; but he was apprehended as a thief, and obliged to pay a considerable sum before he could obtain his liberty.*

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* In the year 1769, the dearest kinds in England were *Don Quevedo* and *Valentinier*; the former cost 2*l.* 2*s.* and the latter 2*l.* 12*s.* 6*d.* See Weston's *Botanicus Universalis,* part 2d. In the German catalogues none of the prices are so high. The name *Semper Augustus* is not once to be found in new catalogues.

Reimman and others accuse Just. Lipsius of the Tulipomania; † but if by this word we understand that gambling traffic which I have described, the accusation is unfounded. Lipsius was fond of scarce and beautiful flowers, which he endeavoured to procure by the assistance of his friends, and which he cultivated himself with great care in his garden; but this taste can by no means be called a mania.‡ Other learned men of the same age were fond of flowers, such as John Barclay,* Pompeius de Angelis,† and others, who would probably have been so, even though the cultivation of flowers had not been the prevailing taste. It however cannot be denied, that learned men may be infected with epidemical follies. In the present age, many have become physiognomists, because physiognomy is in fashion; and even animal magnetism has met with partisans to support it.

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* Blainville's Travels.

† Reimman's Introductio in Histor. Litterariam, iii. 3. p. 98.

‡ That he might relax and refresh his mind worn out by study, he amused himself with the cultivation of his garden and of flowers,

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and particularly of tulips, the roots of which he was at great pains to procure from all parts of the world, by means of Dodonæus, Clusius, and Boisotus, men singularly well skilled in horticulture, and by others of his friends.—Here, at a distance from civil tumult, with a cheerful countenance and placid eye, he sauntered through his plants and flowers, contemplating sometimes one declining, sometimes another springing up, and forgetting all his cares amidst the pleasure which these objects afforded him. See the Life of Lipsius, prefixed to the edition of his works printed at Antwerp in 1637. The like account is to be found in *Adami Vitæ philosophorum*. This is confirmed by what Lipsius says himself in his book *De Constantia*, ii. 2, 3. in praise of gardening.

* He rented a house near to the Vatican, with a garden, in which he had planted the choicest flowers, and those chiefly which are not propagated from seeds or roots, but from bulbs. These flowers were not known about thirty years before, nor had they been ever seen at Rome, but lay neglected in the Alps.—Of these flowers, which have no smell, but are esteemed only on account of their colours, Barclay was remarkably fond, and purchased their bulbs at a great price. *Erythræi Pinacotheca*. Lipsiæ 1712. 8vo. iii. 17. p. 623. See also *Pauli Freheri Theatrum*, p. 1515.

† Erythr. Pinacoth. iii. 24. p. 650.

CANARY BIRD.

This little bird, highly esteemed for its song, which is reared with so much care, particularly by the fair sex, and which affords an innocent amusement to those who are fond of the wild notes of nature, is a native of those islands from which it takes its name. As it was not known in Europe till the fifteenth century, no account of it is to be met with in any of the works of the old ornithologists. Bellon, who about the year 1555 described all the birds then known, does not so much as mention it. At that period it was brought from the Canary Islands. It was therefore so dear that it could be procured only by people of fortune, and those who purchased were even often imposed on.* It was called the sugar-bird, because it was said to be fond of the sugar-cane, and that it could eat sugar in great abundance. This circumstance seems to be very singular; for that salt is to many fowls a poison. Experiments have shewn, that a pigeon to which four drams of sugar was given died in four hours, and that a duck which had swallowed five drams did not live seven hours after. It is certain, therefore, that the power of poison is relative.

The first figure of this bird is given by Aldrovandus,* but it is small and inaccurate. That naturalist reckons the Canary bird among the number of those which were scarce and expensive, as it was brought from a distant country with great care and attention. The first good figure of it is to be found in Olina:† it has been copied by both Johnston and Willughby.

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* Gesneri Historiæ Animalium liber tertius. Tiguri 1555. fol. p. 234.

In the middle of the 17th century these birds began to be bred in Europe, and to this the following circumstance, related by Olina, seems to have given occasion. A vessel, which, among other commodities, was carrying a number of Canary birds to Leghorn, was wrecked on the coast of Italy; and these birds, being thus set at liberty, flew to the nearest land, which was the Island of Elba, where they found the climate so favourable, that they multiplied, and perhaps would have become domesticated, had they not been caught in snares; for it appears that the breed of them there has been long since destroyed.‡ Olina says, that the breed soon degenerated; but it is probable that these Canary birds, which were perhaps all males, did at the Island of Elba what the European sailors do in India. By coupling with the birds of the island, they may have produced mules. Such bastards are described by Gesner and other naturalists.*

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* Aldrovandi Ornithologiæ tomus alter. Francofurti 1610. fol. p. 355. tab. 14. fig. 31.

† Uccelliera, overo Discorso della natura di diversi uccelli—opera di Gio. Pietro Olina. In Roma 1622. 4to. p. 7.

‡ They are not named by Köstlin among the birds which he observed at Elba.

The breeding of these birds was at first attended with great difficulty; partly because the treatment and attention they required were not known, and partly because males chiefly, and few females, were brought to Europe. We are told, that the Spaniards once forbade the exportation of males, that they might secure to themselves the trade carried on in these birds, and that they ordered the bird-catchers either to strangle the females or to set them at liberty.† But this order seems to have been unnecessary; for, as the females commonly do not sing, or are much inferior in the strength of their notes to the males, the latter only were sought after as objects of trade. In the like manner, as the male parrots are much superior in colour to the females, the males are more esteemed, and more of them are brought to Europe than of the females. It is probable, therefore, that, in our system of ornithology, many female parrots belonging to a species already well known are considered as a distinct species. It was at first believed, that those Canary birds bred in the Canary Islands were much better singers than those reared in Europe;* but this at present is doubted.† In latter times various treatises have been published in different languages, on the manner of breeding these birds, and many people have made it a trade, by which they have acquired considerable gain. It does no discredit to the industry of the Tyrolese that they have carried it to the greatest extent. At Ymst, there is a company, who, after the breeding season is over, send out persons to different parts of Germany and Swisserland to purchase birds from those who breed them. Each person brings with him commonly from three to four hundred, which are afterwards carried for sale, not only through every part of Germany, but also to England, Russia, and even Constantinople. About sixteen hundred are brought every year to England; where the dealers in them, notwithstanding the considerable expense they are at, and after carrying them about on their backs, perhaps a hundred miles, sell them for five shillings a piece. This trade, hitherto neglected, is now carried on in Schwarzwalde; and at present there is a citizen here at Göttingen, who takes with him every year to England several Canary birds and bulfinches (*loxia pyr-*

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* Gesneri redivivi, aucti et emendati tomus ii. Franc. 1669. fol. p. 62. More information respecting such bastards may be found in Ornithologie par Brisson, t. iii. Paris 1760. 4to. p. 187. Hallens Naturgeschichte der Thiere, ii. p. 370. and Frisch, Vorstellung der vögel in Teutschland, the twelfth plate of which contains several good figures.

† Coleri Oeconomia ruralis et domestica. Franc. 1680. folio. i. p. 621.

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* General history of America, with Baumgarten's preface, vol. i. p. 557.

† Barrington's paper in the Philos. Trans. vol. lxiii. p. 249.

rhula), with the produce of which he purchases such small wares as he has occasion for.

The principal food of these birds is the Canary seed, which, as is commonly affirmed, and not improbably, was first brought, for this purpose, from the Canary Islands to Spain, and thence dispersed all over Europe. Most of the old botanists, however, are of opinion, that the plant which produces it is the same as that called *phalaris* by Dioscorides.* Should this be true, it will follow that this kind of grass must have grown wild in other places besides the island it takes its name from; which is not improbable. But those who read the different descriptions which the ancients have given of *phalaris*, will, in my opinion, observe that they may be equally applied to more plants; and Pliny seems to have used this name for more than one species of grass.†

However this may be, it is certain that this seed, when it was used as food for these birds, began to be cultivated first in Spain, and afterwards in the southern parts of France. At present it is cultivated in various parts, and forms no inconsiderable branch of trade, particularly in the island of Sicily,‡ where the plant is called *Scagliuola*, or

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* Phalaris Canariensis. The best figure and description of it are to be found in Schreber's *Beschreibung der Gräser*, ii. p. 83. tab. x. 2.

† Lib. iii. c. 159. and lib. xxvii. c. 12.

‡ Agricoltura, prodotti e commercio della Sicilia; dell' Ab. Domenico Sestini 1778. 8vo.

Scaghiola. The seed is sold principally to the French and the Genoese. In England, the industrious inhabitants of the Isle of Thanet, particularly those around Margate, gain considerably by this article, as they can easily transport it to London by water.*

That this plant might be cultivated with little trouble in Germany, is shewn by the yearly experience of those who raise it in their gardens, and by its having become so naturalized in some parts of Hesse,† that it propagates by seed of itself in the fields. The use of the seed might also be extended, for it yields a good meal; but the grains are not easily freed from the husks.

I shall here take occasion to remark, that Savary‡ has been guilty of an error, when he says that argol is cultivated in the Canary Islands in order to be sold as food for Canary birds. One may easily perceive that this mistake has arisen from his confounding that moss used for dyeing, with this kind of grass; and I should not have considered it worth notice, had it not been copied into Ludovici's Dictionary of Trade, § from which, perhaps, it may be copied into the works of others.

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* Miller's Gardener's Dictionary. Museum Rusticum.

† C. Moench, Enumeratio plantarum Hassiæ inferioris. Cassellis 1777. 8vo. p. i. 24.

‡ Dictionnaire de Commerce, t. v. Copenhague 1765. fol. p. 1149.

§ In the last edition of 1765, ii. p. 128.

ARGOL.

UNDER the names Orseille, Orceille, Orsolle, Ursolle, Orcheil, Orchel, in Italian Oricello,* Orcella, Roccella, in Dutch Orchillie, and in English Argol, Canary weed or Orchilla weed, is understood a moss used for dyeing, and from which a kind of paint is also prepared. This species of moss, of which the best figure and a full description may be seen in Dillen,† is by Linnæus called *Lichen roccella.* It is found, in abundance, in some of the islands near the African coast, particularly in the Canaries, and in several of the islands in the Archipelago. It grows upright, partly in single partly in double stems, which are about two inches in height. When it is old, these stems are crowned with a button sometimes round, and sometimes of a flat form, which Tournefort, very properly, compares to the excrescences on the arms of the sepia. Its colour is sometimes a light, and sometimes a dark grey. Of this moss with lime, urine, and alkaline salts, is formed a dark red paste, which in commerce has the same name, and which is much used in dyeing. That well-known substance called lacmus is also made of it.

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* In the Dictionary of the Academy della Crusca the word *oricello* is thus explained: Tintura colla quale si tingono i panni, che si fa con orina d'uomo, e con altri ingredienti.

† Dillenii Historia muscorum, Oxonii 1741. 4to. p. 120.

Theophrastus,[*] Dioscorides,[†] and their transcriber Pliny,[‡] give the name of *Phycos thalaſsion* or *pontion* to a plant, which, notwithstanding its name, is not a sea-weed but a moss; as it grew on the rocks of different islands, and particularly on those of Crete or Candia. It had, in their time, been long used for dyeing wool, and the colour it gave when fresh was so beautiful, that it excelled the ancient purple, which was not red, as many suppose, but violet. Pliny tells us, that with this moss dyers gave the ground or first tint to those cloths which they intended to dye with the costly purple. At least, I so understand, with Hardouin and others, the words *conchyliis substernitur*, which the French dyers express by the phrase *donner le pied.*

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[*] Alga marina, το ποντιον φυκος, quam spongiarii pelagicam deferunt, in Creta insula, juxta terram, super saxa plurima optimaque provenit, qua non solum vittas, sed etiam lanas vestesque inficiunt, et quamdiu recens infectio sit, color longe purpuram præstat. *Hist. Plant.* iv. c. 7. p. 82. *ed. Heinsii.*

[†] E phyci marini generibus tertium candidum, nascens in Creta, floridum valde, quod nulla corruptionis labe polluitur. Hoc fuco quidam putant mulieres suum colorem mentiri, cum tamen sit radicula ejusdem nominis qua se fucant. Lib. iv. c. 95.

[‡] Phycos thalassion, id est fucus marinus, lactucæ similis, qui conchyliis substernitur. Tria autem genera ejus. Tertium crispis foliis, quo in Creta vestes tingunt; omnia ejusdem usus. Lib. xxvi. c. 10.

Algæ maris plura genera, uti diximus, longo folio et latiore, rubente, aliave crispo. Laudatissima quæ in Creta insula juxta terram in petris nascitur; tingendis etiam lanis ita colorem alligans, ut elui postea non possit. Lib. xxxii. c. 6.

Though several kinds of moss produce a similar red dye, I agree in opinion with Dillen, that *phycos thalassion* is our argol; for, at present, no species is known which communicates so excellent a colour, and which corresponds so nearly with the description of Theophrastus. Besides, it is still collected in the Grecian islands, and it appears that it has been used there since the earliest ages.*

Tournefort† found this moss in the island Amorgos, which lies on the eastern side of Naxos, and which, at present, is called Morgo. In his time it was sent to England and Alexandria, at the rate of ten rix-dollars per hundred weight; and he says, expressly, that it was common in the other islands. He shews from Suidas, Julius Pollux,‡ and other ancient writers, that this island was once celebrated for a kind of red linen cloth, which in commerce had the name of the island;

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* Hardouin quotes *Aristot. Hist. Animal.* vi. c. 9. edit. Scaligeri. But that naturalist speaks of a sea-weed which was cast on shore by the Hellespont. A dye or paint was made of it, and the people in the neighbourhood imagined that the purple of this sea-weed, which served as food to certain shell-fish, communicated to them their beautiful dye. A proof that sea-weed *(fuci)* can communicate a red colour, may be found in the Transactions of the Swedish Academy, iv. p. 29.

† Voyage du Levant. Amsterd. 1718. 4to. i. p. 89.

‡ Præterea Amorgina, optima quidem in Amorgo fiunt, sed et hæc e lino esse asserunt. Tunica autem Amorgina, etiam amorgis nuncupatur. *Onomasticon,* vii. c. 16.

and he conjectures, not without probability, that it might have been dyed with this moss.

Imperati[*] says, that the *roccella* of which he gives a figure, was procured from the Levant. This naturalist gives the figure also of a moss in Candia, used for dyeing, which was then called *rubicula*, and which, as may be seen in Bauhin,[†] is comprehended under the name of Roccella. Whether this be a variation from that species cannot with certainty be determined, from the few observations on which the characterizing of the cryptogamia class of plants depends. Dillen and Linnæus, however, make it a distinct species; and the latter names it *Lichen fuciformis*. This distinction is, perhaps, not improper; for the *rubicula* does not grow like a shrub or bush, as the roccella, but belongs rather to the leafy-formed mosses. Be this as it may, it is certain, as Dillen has remarked, and as I know from my own observation, that *L. fuciformis* is often mixed with the real roccella, and particularly with that brought from the Canary Islands; but whether it be equally good, experience has not yet taught us.

From what has been said, I think, I may venture to conclude that our argol was not unknown to the ancient Grecians. But when was it first employed as a dye by the moderns, and introduced into our commerce? Some writers are of opinion, that this drug was first found in the Canary Islands, and afterwards in the Levant. The use of it, therefore, is not older than the last discovery of that island. That this opinion is false, will appear from what follows.

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[*] Histor. nat. Coloniæ 1695. 4to. lib. xxvii. c. 11.

[†] Pinax plant. p. 365. Hist. plant. iii. 2. p. 796.

Among the oldest and principal Florentine families is that known under the name of the Oricellarii or Rucellarii, Ruscellai or Rucellai, several of whom have distinguished themselves as statesmen, and men of letters.* This family are descended from a German nobleman, named Ferro or Frederigo, who lived in the beginning of the twelfth century.† One of his descendants, in the year 1300, carried on a great trade in the Levant, by which he acquired considerable riches, and returning at length to Florence, with his fortune, first made known in Europe the art of dyeing with argol. It is said, that a little before his return from the Levant, happening to make water on a rock covered with this moss, he observed, that the plant, which was there called *respio* or *respo*, and in Spain *orciglia*, acquired by the urine a purple, or, as others say, a red colour. He, therefore, tried several experiments; and when he had brought to perfection the art of dyeing wool with this plant, he made it known at Florence, where he alone practised it for a considerable time, to the great benefit of the state. From this useful invention, the family received the name of Oricellarii, from which, at last, was formed Rucellai.*

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* Bayle, in his Dictionary, mentions several distinguished persons of this family, some of them under the name of Oricellarius, and others under that of Rucellai. He shews that they all belong to one stock; but of the origin of the name he seems to have been ignorant.

† Other accounts say that he was an Englishman; but the name Frederigo confirms his German extraction.

As several documents, still preserved among the Florentine archives, confirm the above account of the origin of this family name, from the discovery of dyeing with oricello,* we may, in my opinion, consider it as certain that the Europeans, and first the Florentines, were made acquainted with this dye-stuff, and its use, in the beginning of the fourteenth century. At that time, the Italians brought from the East the seeds of many arts and sciences, which, afterwards sown and nurtured in Europe, produced the richest harvests; and nothing is more certain than that the art of dyeing was brought to us from the East by the Italians. I do not believe that the merit of having discovered this dye, by the above-mentioned accident, is due to that Florentine; but I am of opinion that he learnt the art in the Levant, and, on his return, taught it to his countrymen, which was doing them no small service.* After that period, the Italians long procured argol from the Levant for themselves, and afterwards for all Europe. I say for a long time, because since the discovery of the Canary Islands the greater part of that substance has been procured from them.

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* A particular account of this celebrated family is to be found in *Giornale de' Letterati d' Italia*, t. xxxiii. parte i. p. 231. As that extensive work is not common, I shall here transcribe the whole passage. "Among the most ancient and most illustrious families of the city of Florence is that of the Rucellai, which is said to have been transplanted thither, a little after the eleventh century, by a certain military gentleman named Ferro or Frederigo, who came from Germany, where he was honoured on account of the nobility of his birth. This family were called, according to the Latin mode of termination, Oricellarii, which surname was afterwards variously corrupted into Rucellari, Ruscellai, but more commonly into Rucellai. This surname, we are told, took its rise from one of the family, who, about the year 1300, having returned from the Levant, where he had traded many years, and acquired great wealth, brought with him the art of dyeing wool purple, which is called dyeing *in oricello*: for, being about to embark for his own country, he happened to make water on certain plants; and observing that some of them, which had been only besprinkled by the urine, from being green became red, he plucked up one of them, and, having shewn it, found that, in that country, it was called *respio*, and in Spain *orciglia*, and that it was the same as that to which the name of *corallina* was given by botanists. In remembrance of this discovery, he and his posterity were afterwards called *Oricellarii*; which name, by being pronounced short, and a little mutilated, was changed into *Rucellari*, and lastly into *Rucellai*."

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* These documents from the Florentine records may be found in *Dominici Mariæ Manni de Florentinis Inventis Commentarium.* Ferrariæ 1731, 4to. p. 37. from which I have extracted the following: "One of this family resided, formerly, a long time in the Levant, where he carried on trade, according to the custom of the Florentine nation. Being one day in the fields, and happening to make water on a plant, of which there was great abundance, he observed that it immediately became extraordinarily red. Like a prudent man, therefore, he resolved to make use of this secret of nature, which till that time had lain hid; and having made several experiments on that herb, and finding it proper to dye cloth, he sent some of it to Florence, where, being mixed with human urine and other things, it has always been employed to dye cloth purple. This plant, which is called *respo,* is in Spain named *orciglia,* and by botanists commonly *corallina.* The mixture made with it is called *oricello,* and has been of great utility and advantage to the woollen manufacture, which is carried on to greater extent in Florence than in any other city. From this circumstance, the individuals of that family, by being the inventors of oricello, have been called Oricellai, and have been beloved by the people for having procured to them this particular benefit. Thus has written John di Paolo Rucellai [*Manni says, that this learned and opulent man wrote in the year* 1451]; and the same account is still given by dyers in our city, who relate and affirm that their ancestors have for a century exercised the art of dyeing, and that they know the above from tradition."

This is confirmed by another passage: "One of this family, on account of the trade carried on faithfully and honestly by the Florentines, travelled to the Levant, and brought thence to Florence the art, or rather secret, of dyeing in oricello."

These islands, after being a considerable time lost and forgotten, were again discovered about the end of the fourteenth or the beginning of the fifteenth century, and since that time they have been much frequented by the Europeans. One of the first who endeavoured to obtain an establishment there was John de Betancourt, a gentleman of Normandy, who, in 1400, or, as others say, in 1417, landed on Lancerotta. Amongst the principal commodities which this gentleman and other Europeans brought back with them was argol, which was found there more beautiful, and in greater abundance, than any where else; and Betancourt enjoyed in idea the great profit which he hoped to derive from this article in commerce. Glass is surprised that the Europeans, immediately upon their arrival, sought after this moss with as much eagerness and skill as they did after gold in America, though they were not so well acquainted with the former as the latter, before the discovery of these new lands.* But as this is not true, the wonder will cease.

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* In the genealogical history of the noble families of Tuscany and Umbria, written by P. D. Eugenio Gamurrini, and published at Florence 1668—1673, 3 vols. in folio, is the following account, vol. i. p. 274, of the origin of this family.—This family acquired their name from a secret brought by one of them from the Levant, which was that of dyeing in oricello, never before used in this country. On that account they were afterwards called Oricellari, as appears from several records among the archives of Florence, and then by corruption Rucellari and Rucellai. Of their origin many speak, and all agree that they came into Tuscany from Britain.

According to information procured in the year 1731, the island of Teneriff produced annually five hundred quintals of this moss; Canary, four hundred; Forteventura, Lancerotta, and Gomera, three hundred each; and Fero, eight hundred; making in all two thousand six hundred quintals. In the islands of Canary, Teneriff and Palma, the moss belongs to the crown; and in the year 1730, it was let by the king of Spain for one thousand five hundred piastres. The farmers paid then for collecting it from fifteen to twenty rials per hundred weight. In the rest of the islands it belongs to private proprietors, who cause it to be collected on their own account. In the beginning of the last century a hundred weight, delivered on board at Santa Cruz, the capital of Teneriff, was worth from only three to four piastres; but since 1725 it has cost labour amounting to ten piastres, because it has been in great request at London, Amsterdam, Marseilles, and throughout all Italy.* In the year 1726 this moss cost at London eighty pounds sterling per ton, as we are told by Dillen; and in 1730 it bore the same price.

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* The history of the discovery and conquest of the Canary-Islands, by George Glass. London 1764. 4to.

Towards the end of the year 1730, the captain of an English vessel, which came from the Cape de Verd islands, brought a bag of argol to Santa Cruz, by way of trial. He discovered his secret to some Spanish and Genoese merchants, who, in the month of July 1731, resolved to send a ship to these islands. They landed on that of St. Anthony and St. Vincent, where, in a few days, they obtained five hundred quintals of this moss, which they found in such abundance, that it cost them nothing more than a piastre per cent. by way of present to the governor. The argol of the Cape de Verd islands appears larger, richer, and longer than that of the Canaries; and this, perhaps, is owing to its not being collected every year.* Adanson, in 1749, found also the greater part of the rocks in Magdalen island, near Senegal, covered with this moss.† Though the greater part of our argol is, at present, procured from the Canary and Cape de Verd islands, a considerable quantity is procured also from the Levant, from Sicily as Glass says, and from the coast of Barbary; and some years ago the English merchants at Leghorn caused this moss to be collected in the island of Elba, and paid a high price for it.‡

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* This information is to be found in Hellot's Art of dyeing, into which it has been copied, as appears by *Dictionnaire d'histoire naturelle, par Valmont de Bomare,* from an account written by M. Porlier, who was consul at Teneriff in 1731.

Our dyers do not purchase raw argol, but a paste made of it, which the French call *orseille en pâte.* The preparation of it was for a long time kept a secret by the Florentines. The person who, as far as I know, made it first known was Rosetti; who, as he himself tells us, carried on the trade of dyer at Florence. Some information was afterwards published concerning it by Imperati§ and Micheli the botanist.‖ In latter times this art has been much practised in France, England, and

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* As the argol grows in the African islands, and on the coast of Africa, Glass supposes that the Getulian purple of the ancients was dyed with it; but this opinion is improbable, for Horace praises Gætula *murice* tinctas vestes.

† Histoire naturelle du Senegal. Paris 1757. 4to. p. 66.

‡ Lettres sur l'histoire naturelle de l'isle d'Elbe, par Koestlin. Vienne 1780. 8vo. p. 100. Pini Beobachtungen über die eisengruben bey Rio; übersetzt von I. F. Gmelin. Halle 1780. 8vo. p. 97.

§ Lib. xxvii. c. 9.

‖ Nova plantarum genera. Florenciæ 1729.

Holland. Many druggists, instead of keeping this paste in a moist state with urine, as they ought, suffer it to dry, in order to save a little dirty work. It then has the appearance of a dark violet-coloured earth, with here and there some white spots in it.

The Dutch, who have found out better methods than other nations of manufacturing many commodities, so as to render them cheaper, and thereby to hurt the trade of their neighbours, are the inventors also of lacmus,* a preparation of argol, called *orseille en pierre*, which has greatly lessened the use of that *en pâte*, as it is more easily transported and preserved, and fitter for use; and as it is besides, if not cheaper, at least not dearer. This art consists, undoubtedly, in mixing with that commodity some less valuable substance, which either improves or does not much impair its quality, and which at the same time increases its weight.† Thus they pound cinnabar and smalt finer than other nations, and yet sell both these articles cheaper. In like manner they sift cochineal, and sell it at a less price than what is unsifted.

It was for a long time believed that the Dutch prepared their lacmus from those linen rags which in the south of France are dipped in the juice of the *croton tinctorium ;*[*] and this idea appeared the more probable, as most of these *tournesol en drapeaux* were bought up by the Hollanders : but, as they are the greatest adulterators of wine in Europe, they may perhaps have used these rags to colour Pontack and other wines. It is, however, not improbable that they at first made lacmus of them, as their dye approaches very near to that of argol. At present, it is almost certainly known that *orseille en pâte* is the principal ingredient in *orseille en pierre,* that is in lacmus ; and for this curious information we are indebted to Ferber.[†] But whence arises the smell of the lacmus, which appears to me like that of the Florentine iris ? Some of the latter may, perhaps, be mixed with it; for I think I have observed in it small indissoluble particles, which may have been bits of the roots. The addition of this substance can be of no use to improve the dye; but it may increase the weight, and give the lack more body; and perhaps it may be employed to render imperceptible some unpleasant smell, for which purpose the roots of that plant are used on many other occasions.

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* Some translate this word *lacca musica, musiva.*

† As dry lacmus is much cheaper than moist, it may be readily supposed that it is adulterated with sand and other substances. *Valentini Historia simplicium.* Francf. ad Moen. 1716. fol. p. 152.

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[*] This plant grows in the neighbourhood of Montpellier, and, above all, in the flats of Languedoc. In harvest, the time when it is collected, the peasants assemble from the distance of fifteen or twenty leagues around, and each gathers on his own account. It is bruised in a mill, and the juice must be immediately used: some mix with it a thirtieth part of urine. It is poured over pieces of canvass, which they take care to provide, and which they rub between their hands. These rags are dried in the sun, and then exposed, above a stone stove, to the vapour of urine mixed with quick-lime or alum. After they have imbibed the juice of the plant, the same operations are repeated till the pieces of cloth appear of a deep blue colour. They are called in commerce *tournesol en drapeaux.* Large quantities of them are bought up by the Dutch, who make use of them to colour wines and the rinds of their cheese. TRANS.

[†] Linn. Mantissa plantarum, i. p. 132.

Another kind of moss, different from the roccella, which in commerce is known by the names *orseille de terre, orseille d'Auvergne,* is used also for the like purpose; but it contains fewer and weaker colouring particles. This species, in botany, is called *Lichen parellus,*[*] and is distinguished from the roccella by its figure, as it grows only in a thin rind on the rocks. It is collected in Auvergne, on rocks of granite and volcanic productions, and in some parts of Languedoc; the greater part of it is brought from St. Flour. Its name, *perelle,* comes from an old Languedocian word *pére* (*pierre,* a rock[†]); as *roccella,* afterwards transformed into *orseille,* is derived from *rocca.* The use of *perelle* is very trifling: the Dutch purchase it to make lacmus, perhaps on account of its low price. This moss has been found also in Northumberland, but it is not collected there for any purpose.[‡]

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[*] Linn. Mantissa plant. i. p. 132.

[†] See *Garcin,* in Savary's Dictionary of commerce, iii. p. 130.

[‡] The natural history and antiquities of Northumberland. By John Wallis. London 1769. 2 vols. 4to. i. p. 279.

opinion, that this drug was first found in the Canary Islands, and afterwards in the Levant. The use of it, therefore, is not older than the last discovery of that island. That this opinion is false, will appear from what follows.

Among the oldest and principal Florentine families is that known under the name of the Oricellarii or Rucellarii, Ruscellai or Rucellai, several of whom have distinguished themselves as statesmen, and men of letters.* This family are descended from a German nobleman, named Ferro or Frederigo, who lived in the beginning of the twelfth century.† One of his descendants, in the year 1300, carried on a great trade in the Levant, by which he acquired considerable riches, and returning at length to Florence, with his fortune, first made known in Europe the art of dyeing with argol. It is said, that a little before his return from the Levant, happening to make water on a rock covered with this moss, he observed, that the plant, which was there called *respio* or *respo*, and in Spain *orciglia*, acquired by the urine a purple, or, as others say, a red colour. He, therefore, tried several experiments; and when he had brought to perfection the art of dyeing wool with this plant, he made it known at Florence, where he alone practised it for a considerable time, to the great benefit of the state. From this useful invention, the family received the name of Oricellarii, from which, at last, was formed Rucellai.*

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* Bayle, in his Dictionary, mentions several distinguished persons of this family, some of them under the name of Oricellarius, and others under that of Rucellai. He shews that they all belong to one stock; but of the origin of the name he seems to have been ignorant.

† Other accounts say that he was an Englishman; but the name Frederigo confirms his German extraction.

As several documents, still preserved among the Florentine archives, confirm the above account of the origin of this family name, from the discovery of dyeing with oricello,* we may, in my opinion, consider it as certain that the Europeans, and first the Florentines, were made acquainted with this dye-stuff, and its use, in the beginning of the fourteenth century. At that time, the Italians brought from the East the seeds of many arts and sciences, which, afterwards sown and nurtured in Europe, produced the richest harvests; and nothing is more certain than that the art of dyeing was brought to us from the East by the Italians. I do not believe that the merit of having discovered this dye, by the above-mentioned accident, is due to that Florentine; but I am of opinion that he learnt the art in the Levant, and, on his return, taught it to his countrymen, which was doing them no small service.* After that period, the Italians long procured argol from the Levant for themselves, and afterwards for all Europe. I say for a long time, because since the discovery of the Canary Islands the greater part of that substance has been procured from them.

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* A particular account of this celebrated family is to be found in *Giornale de' Letterati d' Italia*, t. xxxiii. parte i. p. 231. As that extensive work is not common, I shall here transcribe the whole passage. "Among the most ancient and most illustrious families of the city of Florence is that of the Rucellai, which is said to have been transplanted thither, a little after the eleventh century, by a certain military gentleman named Ferro or Frederigo, who came from Germany, where he was honoured on account of the nobility of his birth. This family were called, according to the Latin mode of termination, Oricellarii, which surname was afterwards variously corrupted into Rucellari, Ruscellai, but more commonly into Rucellai. This surname, we are told, took its rise from one of the family, who, about the year 1300, having returned from the Levant, where he had traded many years, and acquired great wealth, brought with him the art of dyeing wool purple, which is called dyeing *in oricello*: for, being about to embark for his own country, he happened to make water on certain plants; and observing that some of them, which had been only besprinkled by the urine, from being green became red, he plucked up one of them, and, having shewn it, found that, in that country, it was called *respio*, and in Spain *orciglia*, and that it was the same as that to which the name of *corallina* was given by botanists. In remembrance of this discovery, he and his posterity were afterwards called *Oricellarii*; which name, by being pronounced short, and a little mutilated, was changed into *Rucellari*, and lastly into *Rucellai*."

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* These documents from the Florentine records may be found in *Dominici Mariæ Manni de Florentinis Inventis Commentarium.* Ferrariæ 1731, 4to. p. 37. from which I have extracted the following: "One of this family resided, formerly, a long time in the Levant, where he carried on trade, according to the custom of the Florentine nation. Being one day in the fields, and happening to make water on a plant, of which there was great abundance, he observed that it immediately became extraordinarily red. Like a prudent man, therefore, he resolved to make use of this secret of nature, which till that time had lain hid; and having made several experiments on that herb, and finding it proper to dye cloth, he sent some of it to Florence, where, being mixed with human urine and other things, it has always been employed to dye cloth purple. This plant, which is called *respo,* is in Spain named *orciglia,* and by botanists commonly *corallina.* The mixture made with it is called *oricello,* and has been of great utility and advantage to the woollen manufacture, which is carried on to greater extent in Florence than in any other city. From this circumstance, the individuals of that family, by being the inventors of oricello, have been called Oricellai, and have been beloved by the people for having procured to them this particular benefit. Thus has written John di Paolo Rucellai [*Manni says, that this learned and opulent man wrote in the year* 1451]; and the same account is still given by dyers in our city, who relate and affirm that their ancestors have for a century exercised the art of dyeing, and that they know the above from tradition."

This is confirmed by another passage: "One of this family, on account of the trade carried on faithfully and honestly by the Florentines, travelled to the Levant, and brought thence to Florence the art, or rather secret, of dyeing in oricello."

These islands, after being a considerable time lost and forgotten, were again discovered about the end of the fourteenth or the beginning of the fifteenth century, and since that time they have been much frequented by the Europeans. One of the first who endeavoured to obtain an establishment there was John de Betancourt, a gentleman of Nor-

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* In the genealogical history of the noble families of Tuscany and Umbria, written by P. D. Eugenio Gamurrini, and published at Florence 1668—1673, 3 vols. in folio, is the following account, vol. i. p. 274, of the origin of this family.—This family acquired their name from a secret brought by one of them from the Levant, which was that of dyeing in oricello, never before used in this country. On that account they were afterwards called Oricellari, as appears from several records among the archives of Florence, and then by corruption Rucellari and Rucellai. Of their origin many speak, and all agree that they came into Tuscany from Britain.

Some physicians have doubted respecting secret poison;* and others have only denied that its effects can with certainty be regulated to a fixed time.† I agree in opinion with the latter; but the former can be confuted by many examples both of ancient and modern times: for that the ancients were acquainted with this kind of poison, can be proved by the testimony of Plutarch, Quintilian, and other respectable authors. We are told by Plutarch, that a slow poison, which occasioned heat, a cough, spitting of blood, consumption, and a weakness of intellect, was administered to Aratus of Sicyon;‡ and Quintilian, in his declamations, speaks of this poison in such a manner as proves that it must then have been well

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[*] Heberdeen in *Neuem Hamburgischen magazine*, xvii. p. 219. I am convinced that many of the accounts we have of the extraordinary effects of poison are fabricated, like those mentioned in *Frid. Hoffmanni Dissert. de læsionibus externis, abortivis venenis ac philtris.* Francof. 1729, et recusa Lips. 1755. That author, however, denies some which are true. It is, for example, certain that camphor and rue do not produce the effects ascribed to them by Dioscorides, Paulus Ægineta, and others; but there are, without doubt, other substances which will produce these effects.

[†] Sennerti Institut. medicinæ, ii. 2, 12. edit. Witteberg. 1767. 4to. p. 279.

[‡] He gave to Aratus a poison, not speedy and violent, but of that kind which at first occasions a slow heat in the body, with a weak cough, and then gradually brings on a consumption—οὐκ ὀξὺ καὶ σφοδρὸν, ἀλλὰ τῶν θέρμας τὸ μαλακὰς τὲ πρῶτον ἐν τῷ σώματι καὶ βῆχα κινούντων ἀμβλεῖαν, εἶτα οὕτως κατὰ μικρὸν εἰς φθορὰν περαινόντων. One time, when Aratus spat up blood, he said, "This is the effect of royal friendship." See *Plutarch. vit. Arati.* Basil. 1533. p. 358.

known.[*] It cannot be said that such an invention was too great for that period; or that it required more knowledge of chemistry than any one then possessed; for the Indians, in America, are acquainted with a most perfect poison of this kind, and can employ it with so much skill, that the person to whom it is given cannot guard against the treachery, even with the utmost precaution; but infallibly dies, though in a lingering manner, often after the expiration of some years.[†]

Theophrastus speaks of a poison which could be moderated in such a manner as to have effect in two or three months, or at the end of a year, or two years; and he remarks that the death, the more lingering it was, became the more miserable. This poison was prepared from aconitum, a plant which, on that account, people were forbidden to have in their possession, under pain of capital punishment.[‡] He relates also, that Thrasyas had discovered a method of preparing from other plants a poison which, given in small doses of a dram, occasioned an easy but certain death, without any pain, and which could be kept back for a long time without causing weakness or corruption. This Thrasyas, whose scholar Alexias carried the art still further, was a native of Mantinea, a city in Arcadia,* and is celebrated by Theophrastus on account of his abilities, and particularly his knowledge of botany; but those are mistaken who ascribe to him the discovery of secret poison.†

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[*] Venenum putabis quidquid dederint hæ manus. Et virus præsentaneum paro, quod statim, quod subito corripiat? At quemadmodum mihi supersit ulla defensio? An lentum, et quod tarda peste consumat, scilicet, ut non statim exclames, ut te meum virus bibisse non credas. *Quint. declamat.* xvii. 11. p. 341.

[†] With the poison of the Indians, however, the ancients could not be acquainted, as it is prepared from a plant not known in Europe before the discovery of America. Kalm, in his Travels, does not name it: and in that he has done right; for, as the plant is now to be found every where, no government could guard against a misapplication of it, were it publicly known.

[‡] They say a poison can be prepared from aconite (aconitum) so as to occasion death within a certain period, such as two, three, or

This poison was much used at Rome about two hundred years before the Christian æra. As several persons of distinction died the same year at that period, and of the like distemper, an inquiry being made into the cause, a maid-servant gave evidence against some ladies of the first families, who, she said, prepared and distributed poison;

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six months, a year, and even sometimes two years. Those, we are told, whose constitutions are able to hold out longest, die in the greatest misery; for the body is gradually consumed, and must perish by continual wasting. Those die easiest who die speedily. No remedy has been found out for this poison. *Theophr. Hist. Plant.* ix. c. 16. p. 189.

* Of this Thrasyas and Alexias we know no more than what is to be found in *Fabricii Bibliotheca græca*, vol. xiii. p. 53 and 437. He remarks, that in Theophrastus we must read Μαντινευς, instead of Μαντιευς.

† This is done in a work, collected without judgment, entitled *Nachricht von erfindungen und erfindern.* Hamburg 1707. 12mo. p. 154. The author of this work is, undoubtedly, Paul Jacob Marperger.

and above a hundred and fifty of them were convicted and punished.* As so many had learnt this destructive art, it could not be suppressed; and we find sufficient proofs in the Roman history that it was continually preserved. Sejanus caused such a secret poison to be administered by an eunuch to Drusus, who gradually declined afterwards, as by a consumptive disorder, and at length died.† Agrippina being desirous of getting rid of Claudius, but not daring to dispatch him suddenly, and yet wishing not to leave him sufficient time to make new regulations respecting the succession to the throne, she made choice of a poison which should deprive him of his reason, and gradually consume him. This she caused to be prepared by an expert poisoner, named Locusta, who had been condemned to death for her infamous actions, but saved that she might be employed as a state engine. The poison was given to the emperor in a dish of mushrooms; but as, on account of his irregular manner of living, it did not produce the desired effect, it was assisted by some of a stronger nature.‡ This Locusta prepared also the poison with which Nero dispatched Britannicus, the son of Agrippina, whom his father Claudius wished to succeed him on the throne. As this poison occasioned only a dysentery, and was too slow in its operation, the emperor compelled Locusta by blows, and by threatening her with death, to prepare, in his presence, one more powerful. It was first tried on a kid: but as the animal did not die till the end of five hours, she boiled it a little longer, until it instantaneously killed a pig to which it had been given, and this poison dis-

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* Neque de veneficiis ante eam diem Romæ quæsitum est. *Livius*, lib. viii. c. 18.

† Igitur Sejanus, maturandum ratus, deligit venenum quo paulatim irrepente fortuitus morbus adsimularetur. *Taciti Annal.* lib. iv. c. 8.

‡ The account given by Tacitus deserves to be read: Tum Agrippina, sceleris olim certa et oblatæ occasionis propera, nec ministrorum

egens, de genere veneni consultavit; ne repentino et præcipiti facinus proderetur; silentum et tabidum delegisset, ne admotus supremis Claudius, et dolo intellecto, ad amorem filii rediret; exquisitum placebat, quod turbaret mentem et mortem differret. Deligitur artifex talium vocabulo Locusta, nuper veneficii damnata, et diu inter instrumenta regni habita. - - - Soluta alvus subvenisse videbatur. Igitur exterrita Agrippina - - - Xenophontis medici conscientiam adhibet. Ille, tanquam nisus evomentis adjuvaret, pinnam rapido veneno illitam faucibus ejus demisisse creditur. J. C. W. Mohsen, in his excellent *Beschreibung einer Berlinischen medaillen-sammlung*, part i. Berlin and Leipsic 1773, 4to, p. 261, is of opinion that Tacitus contradicts himself in his account: because he says that Agrippina made choice of a slow poison; and, afterwards, that she was surprised it had not operated more speedily. But Agrippina wished not only that Claudius might be destroyed slowly, but also, and principally, that he might be suddenly deprived of his understanding. As that, however, did not happen, and as she had to apprehend both a change in the succession to the throne, and a detection of the secret poison, she bethought herself of one that was stronger. What Mr. Mohsen says in apology for Xenophon, I shall leave to the judgment of others. With me, the fidelity of the Roman historian has more weight than the integrity of the emperor's physician, who, notwithstanding his love for his country, and the liberality and confidence of the emperor, may have been liable to waver.

patched Britannicus as soon as he had tasted it.* For this service the emperor pardoned Locusta, rewarded her liberally, and gave her pupils whom she was to instruct in her art, in order that it might not be lost.

The art of preparing this poison must have been well understood also at Carthage. When M. Attilius Regulus, the Roman general, who had been taken by the Carthaginians, was sent to Rome to propose to the senate that the Carthaginian prisoners might be restored in exchange for him, he prevented this negotiation, because he knew that a poison had been administered to him, by which the state would soon be deprived of his

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[*] The history of this horrid affair may be found both in Tacitus and Suetonius. From the former, I shall quote only the following words: Primum venenum ab ipsis educatoribus accepit, transmisitque exsoluta alvo parum validum, sive temperamentum inerat, ne statim sæviret. Sed Nero, lenti sceleris impatiens, jubere supplicium veneficæ. - - - Promittenti dein tam præcipitem necem quam si ferro urgeretur, cubiculum Cæsaris juxta decoquitur virus, cognitis antea venenis rapidum; - - - quod ita Britannici cunctos artus pervasit, ut vox pariter et spiritus ejus raperentur. *Tacit. Annal.* xiii. c. 15, 16.

Suetonius says: Britannicum veneno aggressus est. Quod acceptum a quadam Locusta, venenariorum indice, cum opinione tardius cederet, ventre modo Britannici moto; accersitam mulierem sua manu verberavit, arguens pro veneno remedium dedisse. Excusantemque minus datum ad occultandam facinoris invidiam, - - - coegit se coram in cubiculo quam posset velocissimum ac præsentaneum coquere. Deinde in hædo expertus, postquam is quinque horas protraxit; iterum ac sæpius recoctum, porcello objecit. Quo statim exanimato, inferri in triclinium, darique cœnanti secum Britannico imperavit. Et cum ille ad primum gustum concidisset - - - *Suet.* vi. c. 33. Respecting Locusta, see also *Juvenal, sat.* i. 1. 71.

services. He returned, therefore, to Carthage, in compliance with the promise he had made to the enemy, who put him to death with the most exquisite torture.*

All these poisons were prepared from plants, particularly aconite, hemlock, and poppy, or extracted from animal substances. Among those made from the latter, none is more remarkable than that supplied by the sea-hare, *lepus marinus*, with which, as Philostratus says,† Titus was dispatched by Domitian. Without here attempting to define the substances employed by the ancients to compose their poisons, I shall only observe, that the *lepus marinus*, the terrible effects of which are expressly mentioned by Dioscorides,* Galen, Nicander, Ætius,† Ælian,‡ Pliny,§ and others, is that animal called, at present, in the Linnæan System, *aplysia depilans*,|| as Rondelet conjectured, and has been since fully proved by Bohadsch.¶ This animal poison, however, seems to have been seldom used, as it easily betrays itself by some peculiar symptoms. It appears that it was not known to Aristotle, at least he makes no mention of it.** With the far stronger, and now common, mineral

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* This account is given by Aulus Gellius, from the now lost works of Tuditanus, who makes Regulus say: Venenum sibi Carthaginenses dedisse non præsentarium, sed ejusmodi quod mortem in diem proferret; eo consilio ut viveret quidem tantisper quoad fieret permutatio; post autem grassante sensim veneno cor tabesceret. Cicero often speaks of the magnanimity of Regulus; as, for example, in his Oration against Piso, and in his Offices, book iii. chap. 27: but he makes no mention of his having been poisoned. Regulus said, Captivos adolescentes esse et bonos duces, se jam confectum senectute. Valerius Maximus, also, book i. chap. i. 14, says nothing of poison.

† Titum autem, cum post mortem patris annos duos regnasset, a marino lepore interfectum dicunt. Is autem piscis humores quosdam occultos habet mortiferos supra omnia venena quæ mari terrave nascantur. Et Neronem hunc ipsum piscem epulis miscuisse quandoque tradunt adversus homines sibi inimicissimos. Domitianus quoque hoc eodem contra Titum fratrem usus fuisse putatur, quod grave molestumque sibi videretur simul cum fratre humano, benignoque viro imperare. *Apollonii Vit.* lib. vi. c. 14.

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* Lib. ii. c. 18. and vi. c. 30.

† Lib. xii.

‡ Histor. Animal. lib. ii. c. 45.

§ Lib. ix. c. 48. and lib. xxxii. c. 1.

|| In *Systema Nat.* through an error of the press, stands *Laplysia*, which word has since become common. Απλυσια signifies an uncleanness which cannot be washed off; and in Aristotle's History of Animals, b. v. ch. 15. and Pliny, b. ix. ch. 45. it is the name of a kind of mushroom. In the like manner other errors, in the System of Linnæus, have been copied into the works of others, such as *Dytiscus* instead of *Dyticus*, &c.

¶ J. B. Bohadsch *de quibusdam animalibus marinis*. Dresdæ 1761. 4to. p. 1—53. In this work there is a full description, with a figure, of this fish, under the name of Lernæa, which was used in the first editions of Linnæus.

** The accounts given by the ancients of the sea-hare have been collected in *Jacobi Grevini lib. de venenis*, Antverpiæ 1571, p. 209. In the *Annals of Glycas*, iii. p. 185. the edition of Venice in 1729, fol. it is said that Titus was dispatched by this poison. In the first book, p. 27, Glycas says, ὁ λαγωὸς ὁ θαλάσσιος ταχεῖαν καὶ ἀπαραίτητον τὴν φθορὰν ἐπιφέρεται: The sea-hare occasions speedy and inevitable destruction to man. In Gesner's edition of Stephen's Lexicon, there is a double error, where *lepus marinus* is explained by *piscis ex lacertorum genere*. So faulty are the best dictionaries, in regard to the appellations of naturalists.

poisons the ancients were not acquainted; for their arsenic was what we call orpiment, and not that pernicious metallic calx which formed the principal ingredient of those secret poisons which, in latter times, were in France and Italy brought to a diabolical perfection.[*]

No one was ever more infamous by this art than Tophana, or Toffania, a woman who resided first at Palermo, and afterwards at Naples. She sold those drops, which from her acquired the name of *aqua Tophania*, *aqua della Toffana*, and which were called also *acquetta di Napoli*, or only *acquetta*; but she distributed her preparation by way of charity to such wives as wished to have other husbands. From four to six drops were sufficient to destroy a man; and it was asserted that the dose could be so proportioned as to operate in a certain time. As she was watched by the government, she fled to an ecclesiastical asylum; and when Keysler was at Naples in 1730, she was then still living, because no one could, or was willing to, take away her life, while under that protection. At that time she was visited by many strangers out of curiosity.

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[*] See *C. G. Stenzelii Diss. de venenis terminatis et temporaneis, quæ Galli* les poudres de succession *vocant*; *resp.* J. G. Arnold. Vitebergæ 1730. This work contains several historical relations; but the reader is often referred to authors who either do not say that for which they were quoted, or who must relate the same thing in a different manner in some other place. As for example, Galen in b. ii. c. 7. *de antidotis* speaks of poisons, without mentioning secret poison in particular. Avicenna is made to say, in his book *de viribus cordis*, that the Egyptian kings often employed this poison; but if by that quotation we are to understand *Fen. undecima de dispositionibus cordis*, I have sought for this information in vain. In lib. iv. fen. 6. tract. 2. c. 14. or according to the beautiful edition *Venetiis apud Juntas* 1608. 2 vol. fol. ii. p. 210. it is said *Fel canis aquatici interficit post hebdomadam*. Rhodiginus also does not relate that for which he is quoted by Stenzel. p. 7.

In Labat's travels through Italy * we also find some information which may serve, still further, to illustrate the history of Tophania. She distributed her poison in small glass phials, with this inscription, *Manna of St. Nicholas of Bari*, and ornamented with the image of the saint. A miraculous oil, employed by folly in the cure of many diseases, drops from the tomb of that saint which is shown at Bari, in the kingdom of Naples; and on this account it is dispersed in great abundance under the like name. It was therefore the best appellation which Tophania could give to her poison, because the reputed sanctity of it prevented the custom-house officers from examining it too closely. When the viceroy was informed of this, which I think was in 1709, Tophania fled from one convent to another, but was at length seized, and thrown into prison. The clergy raised a loud outcry, on account of this violation of ecclesiastical freedom, and endeavoured to excite the people to insurrection. But they were soon appeased, on a report being spread that Tophania had confessed she had poisoned all the springs in the city. Being put to the rack, she acknowledged her wickedness; named those who had protected her, who were immediately dragged from churches and monasteries; and declared that, the day before she had absconded, she had sent two boxes of her manna to Rome, where it was found in the custom-house, but she did not accuse any one of having ordered it. She was afterwards strangled, and, to mitigate the archbishop, her body was thrown, at night, into the area of the convent from which she had been taken. Tophania, however, was not the only person at Naples who understood the making of this poison; for Keysler says, that, at the time he was there, it was still secretly prepared, and much employed.*

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* Vol. iv. p. 33.

In the year 1659, under the government of pope Alexander VII, it was observed at Rome, that many young married women were left widows, and that many husbands died when they became disagreeable to their wives. Several of the clergy declared also, that for some time past various persons had acknowledged at confession, that they had been guilty of poisoning. As the government employed the utmost vigilance to discover these poisoners, suspicion fell upon a society of young married women, whose president appeared to be an old woman who pretended to foretell future events, and who had often predicted very exactly many deaths to persons who had cause to wish for them. To ascertain the truth, a crafty female, given out to be a person of considerable distinction, was sent to this old woman, pretending that she wished to obtain her confidence, and to procure some of her drops for a cruel and tyrannical husband. The whole society were by this stratagem arrested; and all of them, except the fortune-teller, whose name was Hieronyma Spara, confessed before they were put to the torture.—"Where now," cried she, "are the Roman princes, knights and barons, who "on so many occasions promised me their protection! Where are the ladies who assured me "of their friendship! Where are my children "whom I have placed in so distinguished situations!" In order to deter others from committing the like crime, one Gratiosa, Spara's assistant, three other women, and the obstinate Spara herself, who still entertained hopes of assistance till the last moment, were hanged in the presence of innumerable spectators. Some months after, several more women were executed in the same manner; some were whipt, and others were banished from the country. Notwithstanding these punishments, the effects of this inveterate wickedness have been from time to time remarked. Le Bret, to whom we are indebted for the above account, says,* that Spara was a Sicilian, and acquired her knowledge from Tophania at Palermo. If that be true, the latter must have been early initiated in villany, and must have become when very young a teacher of her infamous art. Keysler calls her a little old woman.

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* Keysler's Fortsetzung neuester reisen. Hannover 1741. p. 234.

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* J. F. le Bret, Magazin zum gebrauche der staaten und-kirchengeschichte, part iv. Francf. and Leips. 1774. 8vo. p. 131—141

The art of poisoning never excited more attention than it did in France about the year 1670.* Mary Margaret d'Aubray, daughter of the lieutenant-civil Dreux d'Aubray, was, in the year 1651, married to the marquis de Brinvillier, son of Gobelin president of the Chamber of accounts, who had a yearly income of thirty thousand livres, and to whom she brought a portion of two hundred thousand. He was mestre de camp of the regiment of Normandy, and during the course of his campaigns became acquainted with one Godin de Sainte Croix,† a young man of a distinguished family, who served as a captain of cavalry in the regiment of Trassy. This young officer, who was then a needy adventurer, became a constant visitor of the marquis, and in a short time paid his addresses to the marchioness, who lost her husband after she had helped to dissipate his large fortune, and was thus enabled to enjoy her amours in greater freedom. Her indecent conduct, however, gave so much uneasiness to her father, that he procured a lettre de cachet, had Sainte Croix arrested, while in a carriage by her side, and thrown into the Bastille.* Sainte Croix there got acquainted with an Italian named Exili, who understood the art of preparing poison, and from whom he learnt it. As they were both set at liberty after a year's imprisonment, Sainte Croix kept Exili with him until he became perfectly master of the art, in which he afterwards instructed the marchioness, in order that she might employ it in bettering the circumstances of both. When she had acquired the principles of the art, she assumed the appearance of a nun, distributed food to the poor, nursed the sick in the Hôtel-Dieu, and gave them medicines, but only for the purpose of trying the strength of her poison undetected on these helpless wretches.† It was said in Paris, by way of satire, that no young physician, in introducing himself to practice, had ever so speedily filled a church-yard as Brinvillier. By the force of money, she prevailed on Sainte Croix's servant, called La Chaussée, to administer poison to her father, into whose service she got him introduced, and also to her brother, who was a counsellor of the parliament, and resided at his father's house. To the former the poison was given ten times before he died; the son died sooner; but the daughter, mademoiselle d'Aubray, the marchioness could not poison, because, perhaps, she was too much on her guard; for a suspicion soon arose that the father and son had been poisoned, and the bodies were opened. She would, however, have escaped, had not providence brought to light the villany.

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* The following account is collected from Causes celèbres et intéressantes, par M. Guyot de Pitaval, tome i. à la Haye 1737. 8vo. p. 267—326. Recueil des lettres de Mad. la marquise de Sevigné. A Paris 1754. iv. p. 44—198. Histoire du regne de Louis XIV, par M. de Reboulet. Avignon 1746. v. p. 159. Histoire de la vie et du regne de Louis XIV, publiée par M. Bruzen de la Martiniere, à la Haye 1740. iv. p. 229. Le siècle de Louis XIV, par Voltaire. Berlin 1751. ii. p. 59. Mémoires et réflexions sur les principaux evénemens du regne de Louis XIV, par M. L. M. D. L. F. A Rotterdam 1716. p. 209—214.

† In the account of Martiniere there are several errors: among these is, that he calls Godin, l'abbé *de la Croix*.

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* Voltaire says, that the father did not get Sainte Croix thrown into the Bastille, but sent to his regiment. This, however, is not the case; for this reprobate was at that time not in the army.

† This circumstance is denied by Voltaire, but only, as appears, to contradict Pitaval, whom he calls *un avocat sans cause.*

Sainte Croix, when preparing poison, was accustomed to wear a glass mask; but as this once happened to drop off by accident, he was suffocated, and found dead in his laboratory. Government caused the effects of this man, who had no family, to be examined, and a list of them to be made out. On searching them, there was found a small box, to which Sainte Croix had affixed a written request, that after his death it might be delivered to the marchioness de Brinvillier, or, in case she should not be living, that it might be burnt.*

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* This request was as follows: "I humbly beg that those into "whose hands this box may fall, will do me the favour to deliver it "into the hands only of the marchioness de Brinvillier, who resides in

Nothing could be a greater inducement to have it opened than this singular petition; and that being done, there was found in it a great abundance of poisons of every kind, with labels on which their effects, proved by experiments made on animals, were marked. When the marchioness heard of the death of her lover and instructor, she was desirous to have the casket, and endeavoured to get possession of it, by bribing the officers of justice; but as she failed in this, she quitted the kingdom. La Chaussée, however, continued at Paris, laid claim to the property of Sainte Croix, was seized and imprisoned, confessed more acts of villany than were suspected; and was, in consequence, broke alive on the wheel in 1673.

A very active officer of justice, named Desgrais, was dispatched in search of the marchioness de Brinvillier, who was found in a convent at Liege, to which she had fled from England. To entice her from this privileged place, which folly had

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" the street Neuve Saint Paul, as every thing it contains concerns her, " and belongs to her alone; and as, besides, there is nothing in it that " can be of use to any person except her; and in case she shall be dead " before me, to burn it, and every thing it contains, without opening " or altering any thing; and, in order that no one may plead igno- " rance, I swear by the God whom I adore, and by all that is most " sacred, that I advance nothing but what is true. And if my in- " tentions, just and reasonable as they are, be thwarted in this point, " I charge their consciences with it, both in this world and the next, " in order that I may unload mine, protesting that this is my last " will. Done at Paris this 25th of May in the afternoon, 1672.

" DE SAINTE CROIX."

consecrated for the protection of vice, Desgrais assumed the dress of an abbé, found means to get acquainted with her, acted the part of a lover, and, having engaged her to go out on an excursion of pleasure, arrested her. Among her effects at the convent, there was found a confession, written by her own hand, which contained a complete catalogue of her crimes. She there acknowledged that she had set fire to houses, and that she had occasioned the death of more persons than any one ever suspected. She remarked also, that she had continued a virgin only till the seventh year of her age. Notwithstanding all the craft which she employed to escape, she was conveyed to Paris, where she at first denied every thing; and, when in prison, she played picquet to pass away the time. She was, however, convicted, brought to a confession of her enormities, became a convert, as her confessor termed it, and went with much firmness to the place of execution, on the 16th of July, 1676; where, when she beheld the multitude of the spectators, she exclaimed in a contemptuous manner, "You have come to see a fine spectacle!" She was beheaded, and afterwards burnt; a punishment too mild for such an offender.* As she had been amused with some hopes of a pardon, on account of her relations, when she mounted the scaffold, she cried out "*C'est donc tout de bon!*"*

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* Martiniere says that she was burnt alive, together with all the papers respecting her trial. The latter is improbable, and the former certainly false, notwithstanding the account given in the *Encyclopédie*.

Among a number of persons suspected of being concerned in this affair, was a German apothecary, named Glaser, who, on account of his knowledge in chemistry, was intimate with Exili and Sainte Croix. From him they had both procured the materials which they used, and he was some years confined in the Bastille; but the charge against him being more minutely investigated, he was declared innocent, and set at liberty. He was the author of a treatise of chemistry, printed at Paris in 1667, and reprinted afterwards at Brussels in 1676, and at Lyons in 1679.

By the execution of this French Medea, the practice of poisoning was not suppressed; many persons died from time to time under very suspicious circumstances; and the archbishop was informed, from different parishes, that this crime was still confessed, and that traces of it were remarked both in high and in low families. For watching, searching after, and punishing poisoners, a particular court, called the *Chambre de poison*, or *Chambre ardente*, was at length established in 1679. This court, besides other persons, detected two women, named La Vigoreux and La Voisin,* who carried on a great traffic in poisons. The latter was a midwife. Both of them pretended to foretell future events, to call up ghosts, and to teach the art of finding hidden treasures, and of recovering lost or stolen goods. They also distributed philtres, and sold secret poison to such persons as they knew they could depend upon, and who wished to employ them either to get rid of bad husbands, or recover lost lovers. Female curiosity induced several ladies of the first rank, and even some belonging to the court, to visit these women, particularly La Voisin; and who, without thinking of poison, only wished to know how soon a husband, a lover, the king or his mistress, would die. In the possession of La Voisin was found a list of all those who had become dupes to her imposture. They were arrested and carried before the above-mentioned court, which, without following the usual course of justice, detected secret crimes by means of spies, instituted private trials, and began to imitate the proceedings of the holy inquisition. In this list were found the distinguished names of the countess de Soissons, her sister the duchess de Bouillon, and marshal de Luxembourg. The first fled to Flanders to avoid the severity and disgrace of imprisonment; the second saved herself by the help of her friends; and the last, after he had been some months in the Bastille, and had undergone a strict examination, by which he almost lost his reputation, was set at liberty as innocent. Thus did the cruel Louvois, the war minister, and the marchioness de Montespan, ruin those who opposed their measures. La Vigoreux and La Voisin were burnt alive, on the 22d of February 1680, after their hands had been bored through with a red-hot iron, and cut off. Several persons of ordinary rank were punished by the common hangman; those of higher rank, after they had been declared by this tribunal not guilty, were set at liberty; and in 1680 an end was put to the *Chambre ardente*, which in reality was a political inquisition.

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* The following description of Brinvillier may perhaps be of use to our physiognomists: "In order to satisfy the curiosity of those who may be desirous of knowing if such a celebrated criminal partook of the beauties of her sex, I shall observe that nature had not been sparing of them to the marchioness; her features were exceedingly regular, and the form of her face, which was round, was very graceful. This beautiful outside concealed a heart extremely black. Nothing proves more that *metoposcopy*, or the science of physiognomy, is false; for this lady had that serene and tranquil air which announces virtue." *Pitaval*, p. 269.

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* Some information respecting La Voisin may be found in *Lettres historiques et galantes par Madame de C——*. A Cologne. 1709—1711. 4 vols. 12mo. ii. p. 101. and iv. p. 376. The authoress of these letters was Mad. du Noyer.

It is certain that, notwithstanding such punishments, like crimes have given occasion to unjust succession both in Italy and in France, and that attempts have been made for the same purpose even in the northern kingdoms. It is known, that in Denmark count Corfitz de Ulfeld was guilty, though it was not proved, of having intended to give the king a poison, which should gradually destroy him like a lethargy.* Charles XI, also, king of Sweden, died by the effects of such a poison. Having ruined several noble families by seizing on their property, and having after that made a journey to Torneo, he fell into a consumptive disorder, which no medicine could cure. One day he asked his physician, in a very earnest manner, what was the cause of his illness? The physician replied, "Your majesty has been "loaded with too many maledictions." "Yes," returned the king, "I wish to God that the reduc-"tion of the nobility's estates had not taken place, "and that I had never undertaken a journey "to Torneo!" After his death his intestines were found to be full of small ulcers.*

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* Leben des Grafen von Ulfeld, von H. P. aus dem Danischen ubersetzt. Copenhagen und Leipzig 1775. 8vo. p. 200.

The oftener poisoning in this manner happens, the more it is to be wished that preventives and antidotes were found out, and that the symptoms were ascertained; but this is hardly possible as long as it is not known of what the poison properly consists. Governments, however, have wisely endeavoured to conceal the recipes, by suppressing the criminal procedures. Pope Alexander VII caused them to be shut up in the castle of St. Angelo; in France, it is said, they were burnt together with the criminals; in Naples only, the same precaution was not taken. I do not know that observations on the bodies of persons destroyed by slow poison have been ever published; for what Pitaval says on that subject is not sufficient.* People talk of powders and pills, but the greater part of this kind of poison appears to be a clear insipid water, and that prepared by Toffania never once betrayed itself by any particular effects on the body. The sale of aqua-fortis was a long time forbidden at Rome, because it was considered as the principal ingredient; but this is very improbable. At Paris is was once believed that succession powder consisted of diamond dust pounded exceedingly fine. Without assenting to this idea, one may contradict Voltaire, who conceives that diamond dust is not more prejudicial than powder of coral. It may be rather compared to that fine sand which is rubbed off from our mill-stones, and which we would consider and guard against, as a secret poison, were we not highly negligent and careless of our health in the use of food.* In the casket of Sainte Croix were found sublimate, opium, regulus of antimony, vitriol; and a large quantity of poison ready prepared, the principal ingredients of which the physicians were not able to distinguish. Many have affirmed, that sugar of lead was the chief ingredient; † but the consequences of the poison did not seem to indicate the use of that metal. For some years past a harmless plant, which is only somewhat bitter and astringent, the *cymbalaria*, that grows on old walls, ‡ has been loaded with the opprobrium of producing this slow poison, while at the same time it has been celebrated by others on account of its medicinal properties;* but it is, perhaps, not powerful enough to do either mischief or good; and it is probable that it has been added to poisons either through ignorance, or to conceal other ingredients; for the emperor Charles VI, who was king of the Two Sicilies at the time when Toffania was arrested, told his physician Garelli, who communicated the same in a letter † to the celebrated Hoffman, in 1718 or 1719, that the poison of that Italian Circe was composed of an arsenical calx, dissolved in *aqua cymbalariæ*, and which I suppose was rendered stronger and more difficult to be detected by a salt that may be readily guessed. It

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* This anecdote was told to me by the celebrated Linnæus. An account of what appeared on opening the body of this prince may be seen in *Baldingers Neuem magazin für ærzte*, vol. i. p. 91.

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* The lieutenant-civil continued still to grow worse. After having languished a long time, being seized with a loathing of every kind of food presented to him; his vomitings still continuing, and nature being at length exhausted, he expired without any fever. The three last days he had wasted very much; he was become extremely shrunk, and he felt a great heat in his stomach. When opened, that part and the duodenum were found to be black, and sloughing off in pieces; the liver was mortified, and as it were burnt. The counsellor was ill three months, had the like symptoms as the lieutenant-civil, and died in the same manner. When opened, his stomach and liver were found in a similar state. Pages 274, 275.

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* In one year a ton of sand, at least, which is baked with the flour, is rubbed off from a pair of mill-stones. If a mill grinds only 4385 bushels annually, and one allows no more than twelve bushels to one man, a person swallows in a year above six pounds, and in a month half a pound of pulverised sand-stone, which, in the course of a long life, will amount to upwards of three hundred weight. Is not this sufficient to make governments more attentive to this circumstance?

† For the following important information I am indebted to professor Baldinger. It is to be found in *Christiani Henrici Erndl Dissert. de veneno salutem sistens*; *resp. T. Taut.* Lipsiæ 1701. § 21. "There is no doubt that the slow poison of the French and Italians, " commonly called succession powder (*poudre de la succession*), owes " its origin to sugar of lead. I know a chemist, who superintends " the laboratory of a certain prince on the confines of Bohemia, and " who by the orders (perhaps not very laudable) of his patron, has " spent much time and labour in strengthening and moderating " poisons. He has often declared, that of sugar of lead, with the " addition of some more volatile corrosive, a very slow poison could " be prepared; which, if swallowed by a dog or other animal, would " insensibly destroy it, without any violent symptoms, in the course " of some weeks or months."

‡ Antirrhinum cymbalaria. See *Onomatologia medica completa.* Ulm 1753. 8vo. article *Cymbalaria.*

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* J. J. Wepferi Historia cicutæ aquaticæ. Adjectæ sunt dissertationes de thea helvetica ac cymbalaria; curante T. Zwingero. Lugd. Bat. 1733. 8vo.

† Garelli, the emperor's principal physician, lately wrote to me something remarkable in the following words:—"Your elegant dissertation on the errors respecting poisons brought to my recollection a certain slow poison, which that infamous poisoner, still alive in prison at Naples, employed to the destruction of upwards of six hundred persons. It was nothing else than crystallised arsenic, dissolved in a large quantity of water by decoction, with the addition, but for what purpose I know not, of the herb *cymbalaria*. This was communicated to me by his imperial majesty himself, to whom the judicial procedure, confirmed by the confession of the criminal, was transmitted. This water, in the Neapolitan dialect, is called *aqua de Toffnina*. It is certain death, and many have fallen a sacrifice to it." *Fred. Hoffmanni Medicinæ rationalis systematicæ tomus secundus.* Halæ 1729. 4to. p. ii. c. 2. § 19. p. 185.

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is dreadful to think, that this secret poison is administered as a febrifuge by ignorant or unprincipled physicians, quacks, and old women. It drives off obstinate fevers, it is true; but it is equally certain that it hastens death: it is therefore a cure, which is far worse than the disease, and against which governments and physicians cannot exclaim too severely. Let me here be permitted to recommend to the latter the ideas of Mr. Mohsen on this subject,[*] and to chemists the means Mr. Bell employed to analyse these stygian drops.[†] It was remarked at Rome, by accident, that lemon juice and the acid of lemons are, in some measure, counter-poisons; and a physician named Paul Branchaletti, respecting whom I can find no information, wrote a book expressly on this antidote to these drops, according to the account of Keysler, who however adds, "Every thing hitherto found out, supposes that one has taken the drops only for a short time, or that one has had an opportunity to be upon one's guard when suspicious circumstances occurred, and to discover the threatened danger."

It seems to be almost certain that the poisons prepared by Toffania and Brinvillier were arsenical mixtures, or, as Dr. Hahneman[‡] rightly conjectures, arsenical neutral salts. Loss of appetite, faintness, gnawing pains in the stomach, loss of strength without any visible cause, a continual indisposition, followed by a wasting of the lungs, a slow fever, &c., are all symptoms which seem to announce that dangerous semi-metal. The opinion, however, that it was composed of opium and cantharides has, in latter times, received so many confirmations, that one is almost induced to believe that there are more kinds than one of this stygian water. The information given by the abbé Gagliani seems to carry too much weight with it to be denied.[*] It is confirmed also by

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[*] Beschreibung einer medaillen-sammlung, i. p. 148.

[†] The same, p. 186. Of the internal use of arsenic, see *Baldingers Neue magazin für aerzte*, ii. p. 418.

[‡] Ueber die Arsenikvergiftung, ihre hülfe, und gerichtliche ausmittelung. Leips. 1786. 8vo. p. 35.

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[*] On the 20th of December, 1765, died the dauphin, father of Louis XVI, and in 1767 died the dauphiness. It was a public report that they were both dispatched by secret poison: and the gradual decline of their health, the other circumstances which accompanied their illness, and the cabals which then existed at court, make this at least not improbable. Many private anecdotes respecting these events may be found in a book entitled *L'Espion devalisé. Feliciter audax.* London 1782. In page 61 it is said, that on account of the suspicions then entertained, it was wished that information might be procured respecting secret poison, and the methods of preparing it; and that the abbé Gagliani, well known as a writer, has given the following:—" It is certain that in Europe the preparation of these drugs renders them pernicious and mortal. For example, at Naples the mixture of opium and cantharides, in known doses, is a slow poison; the surest of all, and the more infallible as one cannot mistrust it. At first it is given in small doses, that its effects may be insensible. In Italy we call it *aqua di Tufania,* Tufania water. No one can avoid its attacks, because the liquor obtained from that composition is as limpid as rock water, and without taste. Its effects are slow and almost imperceptible: a few drops of it only are poured into tea, chocolate, or soup, &c. There is not

Mr. Archenholz;* but what he says of the use made of Spanish flies, by the Chinese, to invigorate the sixth sense, gives reason to suspect that his voucher is *L'Espion dévalisé*, to whom the abbé Gagliani ascribes the same words. It appears to me, however, if I may be allowed to judge from

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a lady at Naples who has not some of it lying carelessly on her toilette with her smelling-bottles. She alone knows the phial, and can distinguish it. Even the waiting-woman, who is her confidant, is not in the secret, and takes this phial for distilled water, or water obtained by precipitation, which is the purest, and which is used to moderate perfumes when they are too strong.

"The effects of this poison are very simple. A general indisposition is at first felt in the whole frame. The physician examines you, and perceiving no symptoms of disease, either external or internal, no obstructions, no collection of humours, no inflammations, orders detergents, regimen, and evacuation. The dose of poison is then doubled, and the same indisposition continues without being more characterized.—The physician, who can see in this nothing extraordinary, ascribes the state of the patient to viscous and peccant humours, which have not been sufficiently carried off by the first evacuation. He orders a second—a third dose—a third evacuation—a fourth dose. The physician then sees that the disease has escaped him, that he has mistaken it, and that the cause of it cannot be discovered but by changing the regimen. He orders the waters, &c. In a word, the noble parts lose their tone, become relaxed and affected, and the lungs particularly, as the most delicate of all, and one of those most employed in the functions of the animal œconomy. The first illness then carries you off; because the critical accumulation settles always on the weak part, and consequently on the lobes of the lungs; the pus there fixes itself, and the disease becomes incurable. By this method they follow one as long as they choose for months, and for years. Robust constitutions resist a long time. In short, it is not the liquor alone that kills, it is rather the different remedies, which alter and then destroy the temperament, exhaust the strength, extenuate and render one incapable of supporting the first indisposition that comes."

* England und Italien. ii. p. 354.

probabilities, that the poison known in the East Indies under the name of *powst*, is also water which has stood a night over the juice of poppies. It is given in the morning fasting to those persons, and particularly princes, whom people wish to dispatch privately, and without much violence. It consumes them slowly, so that they at length lose all their strength and understanding, and in the end die torpid and insensible.*

WOODEN BELLOWS.

After the discovery of fire, the first instrument employed to blow it, and strengthen it, has, undoubtedly, been a hollow reed, until the art was found out of forming a stick into a pipe by boring it. Our common bellows, which consist of two boards joined together by a piece of leather, and which probably are an imitation of the lungs, appear to have been early known to the Greeks. I have, however, met with no passage in any ancient author from which I could learn the oldest construction of this machine, which in latter times has received many improvements. Had I found such information, I should have endeavoured to explain it, as it would have contributed to enlarge the

knowledge we have of the metallurgy of the ancients.

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* Universal History, xxiii. p. 299. 323.—The information contained there is taken from Fraser's History of Nadir Shaw. Aurengzebe also caused one of his sons to be put to death by this poison.

It may be remarked on the following lines of Virgil,

> ——— Alii taurinis follibus auras
> Accipiunt, redduntque [*]———

that bull's leather is unfit for bellows, and that ox or cow leather only can be used for that purpose;[†] but accuracy is not to be expected in a poet; and besides, Virgil is not the only author who employs the expression *folles taurinos;* for Plautus says also: *Quam folles taurini habent, cum liquescunt petræ, ferrum ubi fit.*[‡]

Strabo[§] tells us, from an old historian, that Anacharsis, the Scythian philosopher, who lived in the time of Solon, invented the bellows, the anchor, and the potter's wheel: but this account is very doubtful, as Pliny, Seneca,[||] Diogenes Laertius,[¶] and Suidas, who likewise speak of the inventions ascribed to that philosopher, mention only the last two, and not the bellows: besides, Strabo himself remarks that the potter's wheel is noticed in Homer, and this poet is certainly older than Anacharsis. The latter, perhaps, became acquainted with that useful instrument during the course of his travels; and, on his return,

made his countrymen first acquainted with it. However this may be, it is well known that the person who introduces a foreign invention among a people, is often considered as the author of it.

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[*] Georg. iv. 171.

[†] Though this requires no confirmation, I shall here add the testimony of Agricola: Corium est bubulum vel equinum; sed bubulum longe multumque præstat equino. *De re metall.* lib. ix. p. 294.

[‡] In Fragmentis. [§] Lib. vii. [||] Epist. 90. [¶] Lib. i. 8.

In the oldest smelting-houses the bellows were worked by men. Refuse, therefore, and other remains of metal are found in places where, at present, no works could be erected, on account of the want of water.

Bellows made with leather, of which I have hitherto spoken, are attended with many inconveniences. They require careful management; are expensive in their repairs; and besides last often not more than six or seven years. If thin leather is employed, it suffers a great deal of the air to escape through it: an evil which must be guarded against by continually besmearing it with train-oil, or other fat substances; and this is even necessary when thick leather is used, to prevent it from cracking in the folds. Damage by fire and water must also be avoided; and every time they are repaired, the leather must be again softened with oil, which occasions a considerable loss of time.

In wooden bellows these inconveniences are partly lessened, and partly remedied. As these bellows, except the pipe, consist entirely of wood, many, who are not acquainted with the construction of them, can hardly conceive the possibility of making such a machine. Though they cannot be properly described without a figure, I shall endea-

vour to give the reader some idea of them by the following short sketch. The whole machine consists of two boxes placed the one upon the other, the uppermost of which can be moved up and down upon the lower one, in the same manner as the lid of a snuff-box, which has a hinge, moves up and down when it is opened or shut; but the sides of the uppermost box are so broad as to contain the lower one between them, when it is raised to its utmost extent. Both boxes are bound together, at the smallest end, where the pipe is, by a strong iron bolt. It may be readily comprehended, that when both boxes fit each other exactly, and the upper one is raised over the under one, which is in a state of rest, the space contained by both will be increased; and consequently more air will rush in through the valve in the bottom of the lower one: and when the upper box is again forced down, this air will be expelled through the pipe. The only difficulty is to prevent the air, which forces its way in, from escaping any where else than through the pipe; for it is not to be expected that the boxes will fit each other so closely as to prevent entirely the air from making its way between them. This difficulty, however, is obviated by the following simple and ingenious method. On the inner sides of the uppermost box there are placed moveable slips of wood, which, by means of metal springs, are pressed to the sides of the other box, and fill up the space between them. As

these long slips of wood might not be sufficiently pliable to suffer themselves to be pressed close enough; and as, though planed perfectly straight at first, they would, in time, become warped in various directions, incisions are made in them across through their whole length, at the distance of from fifteen to eighteen inches from each other, so as to leave only a small space in their thickness, by which means they acquire sufficient pliability to be every where pressed close enough to the sides.[*]

The advantages of these wooden bellows are very great. When made of clean fir-wood without knots, they will last thirty or forty years, and even longer, though continually kept in action forty-six or forty-eight weeks every year: nay, Polhem assures us that, when properly made, they will last a century. The effect produced by them is stronger, as well as more uniform, and can be moderated according to circumstances. They are worked also with greater facility. The slips of wood on their sides are apt to become damaged; but they can soon and easily be repaired. Every three or four months, however, the outer sides only of the

inner box, and the bolt which keeps the boxes together, must be smeared with oil. If we reckon up the price of such bellows, and the yearly expence, they will, according to Grignon's account, be only a fifth part of those of the old leather bellows.

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[*] A complete description and a figure of these bellows may be found in *Schluters Unterricht von hütten-werken.* Brunswick 1738. fol. p. 51; in *Cramers Anfangsgründe der metallurgie.* Blankenburg and Quedlingburg 1777. fol. iii. p. 59; *Mémoires sur l'art de fabriquer le fer, par Grignon.* Paris 1775. 4to. p. 199; *Traité de la fonte des mines par le feu du charbon de terre*; par M. de Genssane. Paris 1770. 2 vol. 4to. i. p. 96; *Pini de venarum metallicarum excoctione.* Vindobonæ 1780. 4to. vol. i. p. 107.

That the invention of these wooden bellows belongs to the Germans, is certain. Grignon * expressly affirms so; and in Becher's † time they were to be found in Germany, but not in England. Genssane, who ascribes the invention to the Swiss, is certainly mistaken; and perhaps he was led into this error, because these bellows were first made known in France by a Swiss. I cannot, however, ascertain the name of the real inventor. In the middle of the sixteenth century lived at Nuremberg an artist called Hans Lobsinger, who, in the year 1550, gave to the magistrates of that city a catalogue of his machines. From this catalogue Doppelmayer concludes that he understood the art of making small and large bellows without leather, and entirely of wood, which could be used in smelting-houses and for organs, and likewise copper bellows that always

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* Germany is the country of machines. In general the Germans lessen manual labour considerably by machines adapted to every kind of movement; not that we are destitute of able mechanics; we have the talent of bringing to perfection the machines invented by our neighbours. P. 200.

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To these bellows Schluter has assigned a much nobler inventor, who, perhaps, was the first person who made them known by a description. He says expressly that they were invented by a bishop of Bamberg:* but of this I have been able to find no confirmation; and I am inclined to ascribe that service rather to an organ-builder, or a miller, than to a bishop. According to Schluter's account, these bellows were employed so early as the year 1620, in the forest of Harze, to which they were first brought by some people from Bamberg. What Calvor says respecting the introduction of these bellows into the forest of Harze is much more probable: that in the year 1621 Lewis Pfannenschmid, from Thuringia, settled at Ostfeld near Goslar, and began to make wooden bellows. The bellows-makers of that place conspired therefore against him, and swore they would put him to death; but he was protected by the government. He would disclose his art to no one but his son, who, as well as his grandson a few years ago, had the making of all the bellows in the forest.

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COACHES.

If by this name we are to understand every kind of covered carriage, in which one can with convenience travel, there is no doubt that some of them were known to the ancients. The *arcera*, of which mention is made in the twelve tables, was a covered carriage used by sick and infirm persons.[*] It appears to have been employed earlier than the soft *lectica*, and by it to have been brought into disuse. A later invention is the *carpentum*, the form of which may be seen on antique coins, where it is represented as a two-wheeled car, with an arched covering, and which was sometimes hung with costly cloth.[†] Still later were introduced the *carrucæ*, first mentioned by Pliny; but so little is known of them, that antiquaries are uncertain whether they had only one wheel, like our wheel-barrows, or, as is more probable, four wheels.[‡] This much, however, is known, that they were first-rate vehicles, ornamented with gold and precious stones, and that the Romans considered it as an

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[†] Scheffer de re vehiculari, in Utriusque thesauri antiquitatum nova supplementa congesta a Poleno. Venetiis 1737, fol. v. p. 1380. Spanhem. de præstant. numismatum. Amst. 1671. 4to. p. 613. Propertius, iv. 8. 23. mentions *serica carpenta*.

[‡] Scheffer, l. c. p. 1472.

Mr. Archenholz;* but what he says of the use made of Spanish flies, by the Chinese, to invigorate the sixth sense, gives reason to suspect that his voucher is *L'Espion dévalisé*, to whom the abbé Gagliani ascribes the same words. It appears to me, however, if I may be allowed to judge from

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a lady at Naples who has not some of it lying carelessly on her toilette with her smelling-bottles. She alone knows the phial, and can distinguish it. Even the waiting-woman, who is her confidant, is not in the secret, and takes this phial for distilled water, or water obtained by precipitation, which is the purest, and which is used to moderate perfumes when they are too strong.

"The effects of this poison are very simple. A general indisposition is at first felt in the whole frame. The physician examines you, and perceiving no symptoms of disease, either external or internal, no obstructions, no collection of humours, no inflammations, orders detergents, regimen, and evacuation. The dose of poison is then doubled, and the same indisposition continues without being more characterized.—The physician, who can see in this nothing extraordinary, ascribes the state of the patient to viscous and peccant humours, which have not been sufficiently carried off by the first evacuation. He orders a second—a third dose—a third evacuation—a fourth dose. The physician then sees that the disease has escaped him, that he has mistaken it, and that the cause of it cannot be discovered but by changing the regimen. He orders the waters, &c. In a word, the noble parts lose their tone, become relaxed and affected, and the lungs particularly, as the most delicate of all, and one of those most employed in the functions of the animal œconomy. The first illness then carries you off; because the critical accumulation settles always on the weak part, and consequently on the lobes of the lungs; the pus there fixes itself, and the disease becomes incurable. By this method they follow one as long as they choose for months, and for years. Robust constitutions resist a long time. In short, it is not the liquor alone that kills, it is rather the different remedies, which alter and then destroy the temperament, exhaust the strength, extenuate and render one incapable of supporting the first indisposition that comes."

* England und Italien. ii. p. 354.

probabilities, that the poison known in the East Indies under the name of *pou'st*, is also water which has stood a night over the juice of poppies. It is given in the morning fasting to those persons, and particularly princes, whom people wish to dispatch privately, and without much violence. It consumes them slowly, so that they at length lose all their strength and understanding, and in the end die torpid and insensible.*

WOODEN BELLOWS.

After the discovery of fire, the first instrument employed to blow it, and strengthen it, has, undoubtedly, been a hollow reed, until the art was found out of forming a stick into a pipe by boring it. Our common bellows, which consist of two boards joined together by a piece of leather, and which probably are an imitation of the lungs, appear to have been early known to the Greeks. I have, however, met with no passage in any ancient author from which I could learn the oldest construction of this machine, which in latter times has received many improvements. Had I found such information, I should have endeavoured to explain it, as it would have contributed to enlarge the

knowledge we have of the metallurgy of the ancients.

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* Universal History, xxiii. p. 299. 323.—The information contained there is taken from Fraser's History of Nadir Shaw. Aurengzebe also caused one of his sons to be put to death by this poison.

It may be remarked on the following lines of Virgil,

——— Alii taurinis follibus auras
Accipiunt, redduntque [*] ———

that bull's leather is unfit for bellows, and that ox or cow leather only can be used for that purpose;[†] but accuracy is not to be expected in a poet; and besides, Virgil is not the only author who employs the expression *folles taurinos;* for Plautus says also: *Quam folles taurini habent, cum liquescunt petræ, ferrum ubi fit.*[‡]

Strabo[§] tells us, from an old historian, that Anacharsis, the Scythian philosopher, who lived in the time of Solon, invented the bellows, the anchor, and the potter's wheel: but this account is very doubtful, as Pliny, Seneca,[||] Diogenes Laertius,[¶] and Suidas, who likewise speak of the inventions ascribed to that philosopher, mention only the last two, and not the bellows: besides, Strabo himself remarks that the potter's wheel is noticed in Homer, and this poet is certainly older than Anacharsis. The latter, perhaps, became acquainted with that useful instrument during the course of his travels; and, on his return,

made his countrymen first acquainted with it. However this may be, it is well known that the person who introduces a foreign invention among a people, is often considered as the author of it.

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[*] Georg. iv. 171.

[†] Though this requires no confirmation, I shall here add the testimony of Agricola: Corium est bubulum vel equinum; sed bubulum longe multumque præstat equino. *De re metall.* lib. ix. p. 294.

[‡] In Fragmentis. [§] Lib. vii. [||] Epist. 90. [¶] Lib. i. 8.

In the oldest smelting-houses the bellows were worked by men. Refuse, therefore, and other remains of metal are found in places where, at present, no works could be erected, on account of the want of water.

Bellows made with leather, of which I have hitherto spoken, are attended with many inconveniences. They require careful management; are expensive in their repairs; and besides last often not more than six or seven years. If thin leather is employed, it suffers a great deal of the air to escape through it: an evil which must be guarded against by continually besmearing it with train-oil, or other fat substances; and this is even necessary when thick leather is used, to prevent it from cracking in the folds. Damage by fire and water must also be avoided; and every time they are repaired, the leather must be again softened with oil, which occasions a considerable loss of time.

In wooden bellows these inconveniences are partly lessened, and partly remedied. As these bellows, except the pipe, consist entirely of wood, many, who are not acquainted with the construction of them, can hardly conceive the possibility of making such a machine. Though they cannot be properly described without a figure, I shall endea-

vour to give the reader some idea of them by the following short sketch. The whole machine consists of two boxes placed the one upon the other, the uppermost of which can be moved up and down upon the lower one, in the same manner as the lid of a snuff-box, which has a hinge, moves up and down when it is opened or shut; but the sides of the uppermost box are so broad as to contain the lower one between them, when it is raised to its utmost extent. Both boxes are bound together, at the smallest end, where the pipe is, by a strong iron bolt. It may be readily comprehended, that when both boxes fit each other exactly, and the upper one is raised over the under one, which is in a state of rest, the space contained by both will be increased; and consequently more air will rush in through the valve in the bottom of the lower one: and when the upper box is again forced down, this air will be expelled through the pipe. The only difficulty is to prevent the air, which forces its way in, from escaping any where else than through the pipe; for it is not to be expected that the boxes will fit each other so closely as to prevent entirely the air from making its way between them. This difficulty, however, is obviated by the following simple and ingenious method. On the inner sides of the uppermost box there are placed moveable slips of wood, which, by means of metal springs, are pressed to the sides of the other box, and fill up the space between them. As

these long slips of wood might not be sufficiently pliable to suffer themselves to be pressed close enough; and as, though planed perfectly straight at first, they would, in time, become warped in various directions, incisions are made in them across through their whole length, at the distance of from fifteen to eighteen inches from each other, so as to leave only a small space in their thickness, by which means they acquire sufficient pliability to be every where pressed close enough to the sides.*

The advantages of these wooden bellows are very great. When made of clean fir-wood without knots, they will last thirty or forty years, and even longer, though continually kept in action forty-six or forty-eight weeks every year: nay, Polhem assures us that, when properly made, they will last a century. The effect produced by them is stronger, as well as more uniform, and can be moderated according to circumstances. They are worked also with greater facility. The slips of wood on their sides are apt to become damaged; but they can soon and easily be repaired. Every three or four months, however, the outer sides only of the

inner box, and the bolt which keeps the boxes together, must be smeared with oil. If we reckon up the price of such bellows, and the yearly expence, they will, according to Grignon's account, be only a fifth part of those of the old leather bellows.

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* A complete description and a figure of these bellows may be found in *Schluters Unterricht von kütten-werken*. Brunswick 1738. fol. p. 51; in *Cramers Anfangsgründe der metallurgie*. Blankenburg and Quedlingburg 1777. fol. iii. p. 59; *Mémoires sur l'art de fabriquer le fer, par Grignon*. Paris 1775. 4to. p. 199; *Traité de la fonte des mines par le feu du charbon de terre*; par M. de Genssane. Paris 1770. 2 vol. 4to. i. p. 96; *Pini de venarum metallicarum excoctione*. Vindobonæ 1780. 4to. vol. i. p. 107.

That the invention of these wooden bellows belongs to the Germans, is certain. Grignon * expressly affirms so; and in Becher's † time they were to be found in Germany, but not in England. Genssane, who ascribes the invention to the Swiss, is certainly mistaken; and perhaps he was led into this error, because these bellows were first made known in France by a Swiss. I cannot, however, ascertain the name of the real inventor. In the middle of the sixteenth century lived at Nuremberg an artist called Hans Lobsinger, who, in the year 1550, gave to the magistrates of that city a catalogue of his machines. From this catalogue Doppelmayer concludes that he understood the art of making small and large bellows without leather, and entirely of wood, which could be used in smelting-houses and for organs, and likewise copper bellows that always

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‡ Scheffer, l. c. p. 1472.

After this, covered carriages seem more and more to have become appendages of Roman pomp and magnificence; but the manner of thinking which prevailed under the feudal system banished the use of them, for some time. As it was of the greatest importance to the feudal lords that their vassals should be always able to serve them on horseback, they could not think of indulging them with elegant carriages. They foresaw, that by such luxury the nobility would give over riding on horseback, and become much more indolent, and less fit for military service. Masters and servants, husbands and wives, clergy and laity, all rode upon horses or mules, and sometimes women and monks upon she-asses, which they found more convenient. The minister rode to court; and the horse, without any conductor, returned alone to his stable, till a servant carried him back to court to fetch his master.[‡]

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[*] Alii summum decus in carrucis solito altioribus ponunt. In my opinion the height here alluded to is to be understood as that of the body, rather than that of the wheels, as some think.

[†] Omnes honorati, seu civilium seu militarium, vehiculis dignitatis suæ, id est carrucis, intra urbem sacratissimi nominis semper utantur. *Codex Theodos.* lib. xiv. tit. 12. and *Cod. Justin.* lib. xi. tit. 19.

[‡] C. A. Geutebruck, Gedanken und anmerkungen über die einrichtung einer kammer-verwaltung. Erfurt 1765. 8vo. p. 11.

In this manner the magistrates of the imperial cities rode to council, in the beginning of the sixteenth century; so that, in the year 1502, steps to assist in mounting were erected by the Roman gate at Francfort.* The members of the council, who, at the diet, and on other occasions, were employed as ambassadors, were, on this account, called *rittmeister*;† and even at present the expression *riding servant* is preserved in some of the imperial cities. The public entry of great lords into any place, or their departure from it, was never in a carriage, but on horseback; and in all the works which speak of the papal ceremonies, there is no mention of a state coach, or body coachman, but of state horses, or state mules. It was necessary that a horse for his holiness should be of a grey colour; not mettlesome, however, but a quiet tractable nag; that a stool with three steps should be brought to assist him to mount, and the emperor and kings, if present, were obliged to hold his stirrup, and to lead the horse,‡ &c. Bishops made their public entrance on horses or asses richly decorated.§ At the coronation of the emperor, the electors and principal officers of the empire were ordered to make their entrance on horses, and to perform their service on horseback.* Formerly it was requisite that those who received an investiture should make their appearance on horseback: the vassal was obliged to ride with two attendants to his lord's court, where, having dismounted from his horse, he received his fief.

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* Lersner, Chronica der Stadt Frankfurt. i. p. 23.

† Lehmanns Chronica der Stadt Speier. Frankfurt 1698. fol. p. 618.

‡ Sacrarum cæremoniarum Romanæ ecclesiæ libri tres, auctore J. Catalano. Romæ 1750. 2 vol. fol. i. p. 131.

§ See J. P. Ludewigs Gelehrte anzeigen, welche vormals den Wöchentlichen Hallischen Anzeigen einverleibt worden, nunmehro

Covered carriages were known in the beginning of the sixteenth century; but they were used only by women of the first rank, for the men thought it disgraceful to ride in them. At that period, when the electors and princes did not choose to be present at the meetings of the states, they excused themselves by informing the emperor that their health would not permit them to ride on horseback; and it was considered as an established point, that it was unbecoming for them to ride like women.† What, according to the then prevailing ideas, was not allowed to princes, was much less permitted to their servants. In the year 1544, when count Wolf of Barby, was summoned by John Frederic, elector of Saxony, to go to Spires to attend the convention of the states assembled there, he requested leave, on account of his ill state of health,

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aber zusammen gedruckt. Halle 1743. 3 vol. 4to. i. p. 426. where the following passage is quoted from *Ceremoniale Episcoporum*, lib. i. c. 11. Episcopus ascendet mulam ornatam pontificalibus ephippiis et stragula violacei coloris, ac ita equitabit.

* Ludewigs Erläuter. der Güldenen Bulle. Franc. 1719. 2 vol. 4to. i. p. 569.

† Von Ludolf, Electa juris publici, v. p. 417.

to make use of a close carriage with four horses. When the counts and nobility were invited to the marriage solemnity of the elector's half brother, duke John Ernest, the invitation was accompanied with a memorandum, that such dresses of ceremony as they might be desirous of taking with them should be transported in a small waggon.* Had they been expected in coaches, such a memorandum would have been superfluous. The use of covered carriages was, for a long time, forbidden even to women. In the year 1545, the wife of a certain duke obtained from him, with great difficulty, permission to use a covered carriage in a journey to the baths, in which, however, much pomp was displayed; but with this express stipulation, that her attendants should not have the same indulgence.† It is nevertheless certain, that the emperor, kings, and princes, about the end of the fifteenth century, began to employ covered carriages on journeys, and afterwards on public solemnities.

In the year 1474, the emperor Frederic III came to Francfort in a close carriage; and as he remained in it on account of the wetness of the weather, the inhabitants had no occasion to support the canopy which was held over him, but while he went to the council-house, and again returned. In the year following, the emperor visited the same city in a very magnificent covered carriage.* In the description of the splendid tournament held by Joachim elector of Brandenburg, at Ruppin, in 1509, we read of a carriage all gilt over, which belonged to the electress; of twelve other coaches, ornamented with crimson, and of another of the duchess of Mecklenburg, which was hung with red satin. At the coronation of the emperor Maximilian, in the year 1562, the elector of Cologne had twelve carriages. In 1594, when the margrave John Sigismund did homage at Warsaw on account of Prussia, he had in his train thirty-six coaches with six horses each.† Count Kevenhiller, speaking of the marriage of the emperor Ferdinand II with a princess of Bavaria, says, "The bride rode with her sisters in a splendid carriage studded with gold; her maids of honour in carriages hung with black satin, and the rest of the ladies in neat leather carriages." The same author mentions the entrance of cardinal Dietrichstein into Vienna, in 1611, and tells us that forty carriages went to meet him.‡ At the election of the emperor Matthias, the ambassador of

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* Von Ludolf, Electa juris publici, ut supra.

† Sattler, in Historischer bescreibung des herzogthums Würtemberg, im ersten theile, bey erläuterung einer urkunde vom jahr 1389.

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* Lersner, i. p. 106 and 108.

† Suite des Mémoires pour servir à l'Hist. de Brandenburg, p. 63. where the royal author adds, "The common use of carriages is not older than the time of John Sigismund."

‡ Annal. Ferdin. V. p. 2199; and vii. p. 375. Von Mosers Teutsches hofrecht. Franc. and Leipsic 1755. 4to. ii. p. 338.

Brandenburg had three coaches.[*] When the consort of that emperor made her public entrance, on her marriage in 1611, she rode in a carriage covered with perfumed leather.[†] Mary, infanta of Spain, spouse of the emperor Ferdinand III, rode, in Carinthia, in 1631, in a glass carriage in which no more than two persons could sit.[‡] The wedding carriage of the first wife of the emperor Leopold, who was also a Spanish princess, cost together with the harness 38,000 florins.[§] The coaches used by that emperor are thus described by Rink: "In the imperial coaches no great mag-"nificence was to be seen: they were covered over "with red cloth and black nails. The harness was "black, and in the whole work there was no gold. "The pannels were of glass, and on this account "they were called the imperial glass coaches. On "festivals the harness was ornamented with red silk "fringes. The imperial coaches were distinguished "only by their having leather traces; but the la-"dies in the imperial suite were obliged to be con-"tented with carriages the traces of which were "made of ropes." At the magnificent court of duke Ernest Augustus, at Hanover, there were,

vour to give the reader some idea of them by the following short sketch. The whole machine consists of two boxes placed the one upon the other, the uppermost of which can be moved up and down upon the lower one, in the same manner as the lid of a snuff-box, which has a hinge, moves up and down when it is opened or shut; but the sides of the uppermost box are so broad as to contain the lower one between them, when it is raised to its utmost extent. Both boxes are bound together, at the smallest end, where the pipe is, by a strong iron bolt. It may be readily comprehended, that when both boxes fit each other exactly, and the upper one is raised over the under one, which is in a state of rest, the space contained by both will be increased; and consequently more air will rush in through the valve in the bottom of the lower one: and when the upper box is again forced down, this air will be expelled through the pipe. The only difficulty is to prevent the air, which forces its way in, from escaping any where else than through the pipe; for it is not to be expected that the boxes will fit each other so closely as to prevent entirely the air from making its way between them. This difficulty, however, is obviated by the following simple and ingenious method. On the inner sides of the uppermost box there are placed moveable slips of wood, which, by means of metal springs, are pressed to the sides of the other box, and fill up the space between them. As

these long slips of wood might not be sufficiently pliable to suffer themselves to be pressed close enough; and as, though planed perfectly straight at first, they would, in time, become warped in various directions, incisions are made in them across through their whole length, at the distance of from fifteen to eighteen inches from each other, so as to leave only a small space in their thickness, by which means they acquire sufficient pliability to be every where pressed close enough to the sides.*

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[*] In the last-quoted work but one, p. 63, it is remarked that they were coarse coaches, composed of four boards put together in a clumsy manner.

[†] Kevenhiller, Annal. i. p.34.

[‡] Kevenhiller, xi. p. 1503.

[§] Rink, Leben k. Leopold. p.607.

The advantages of these wooden bellows are very great. When made of clean fir-wood without knots, they will last thirty or forty years, and even longer, though continually kept in action forty-six or forty-eight weeks every year: nay, Polhem assures us that, when properly made, they will last a century. The effect produced by them is stronger, as well as more uniform, and can be moderated according to circumstances. They are worked also with greater facility. The slips of wood on their sides are apt to become damaged; but they can soon and easily be repaired. Every three or four months, however, the outer sides only of the

inner box, and the bolt which keeps the boxes together, must be smeared with oil. If we reckon up the price of such bellows, and the yearly expence, they will, according to Grignon's account, be only a fifth part of those of the old leather bellows.

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That the invention of these wooden bellows belongs to the Germans, is certain. Grignon* expressly affirms so; and in Becher's† time they were to be found in Germany, but not in England. Genssane, who ascribes the invention to the Swiss, is certainly mistaken; and perhaps he was led into this error, because these bellows were first made known in France by a Swiss. I cannot, however, ascertain the name of the real inventor. In the middle of the sixteenth century lived at Nuremberg an artist called Hans Lobsinger, who, in the year 1550, gave to the magistrates of that city a catalogue of his machines. From this catalogue Doppelmayer concludes that he understood the art of making small and large bellows without leather, and entirely of wood, which could be used in smelting-houses and for organs, and likewise copper bellows that always

emitted a like degree of wind. As Lobsinger made organs, he, perhaps, fell upon this invention: but in what it actually consisted, or whether it might not die with him, I have not been able to learn. Agricola, who died in the year 1555, makes no mention of wooden bellows.

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* Germany is the country of machines. In general the Germans lessen manual labour considerably by machines adapted to every kind of movement; not that we are destitute of able mechanics; we have the talent of bringing to perfection the machines invented by our neighbours. P. 200.

† Bechers Narrische weisheit und weise narrheit. Frankfort 1683. 12mo. p. 113.

Samuel Reyher, formerly professor at Kiel, in a dissertation on air,* printed there in 1669, tells us, that about forty years before that period, two brothers, Martin and Nicholas Schelhorn, millers at the village of Schmalebuche in Cobourg, first invented wooden bellows. Both the brothers, he says, kept the invention secret, though he thinks they did not conceal it so closely as to prevent its being guessed at; and he relates also how he himself formed an idea of it.†

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* In this dissertation, the time of the invention is stated to be about forty years before, which would be the year 1629 or 1630; but in an improved edition, printed with additions at Hamburg, in 1725, and entitled *De pneumatica, sive De aëre et aërometria*, a different period is given. "About eighty years ago," says the author, "a new kind of "bellows, which ought rather to be called the pneumatic chests, was "invented in the village of Schmalebuche, in the principality of Co-"bourg, in Franconia. Two brothers, millers in that village, Martin "and Nicholas Schelhorn, by means of some box made by them, the "lid of which fitted very exactly, found out these chests, as I was "told by one of their friends, a man worthy of credit. These chests "are not of leather, but entirely of wood joined together with iron "nails. In blacksmiths' shops they are preferred to those construct-"ed with leather, because they emit a stronger blast, as leather suf-"fers the more subtile part of the air to escape through its pores."

† In many places these bellows were at first put in a wooden case, to prevent their construction from being known.

To these bellows Schluter has assigned a much nobler inventor, who, perhaps, was the first person who made them known by a description. He says expressly that they were invented by a bishop of Bamberg:* but of this I have been able to find no confirmation; and I am inclined to ascribe that service rather to an organ-builder, or a miller, than to a bishop. According to Schluter's account, these bellows were employed so early as the year 1620, in the forest of Harze, to which they were first brought by some people from Bamberg. What Calvor says respecting the introduction of these bellows into the forest of Harze is much more probable: that in the year 1621 Lewis Pfannenschmid, from Thuringia, settled at Ostfeld near Goslar, and began to make wooden bellows. The bellows-makers of that place conspired therefore against him, and swore they would put him to death; but he was protected by the government. He would disclose his art to no one but his son, who, as well as his grandson a few years ago, had the making of all the bellows in the forest.

We are told by French authors, that the art of making these bellows was introduced into France, particularly into Berry, Nivernois, and Franche Comté, by a German.

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* In *J. P. Ludewig, Scriptores rerum episcopatus Bambergensis.* Francofurti et Lipsiæ 1718. fol. Where any bishop of latter times is praised, I find no mention of this useful and ingenious invention.

were at Paris, for the first time, only three coaches, one of which belonged to the queen, another to Diana de Poictiers, the mistress of two kings, Francis I and Henry II, by the latter of whom she was created duchess of Valentinois, and the third to René de Laval, lord of Bois-dauphin. The last was a corpulent unwieldy nobleman, who was not able to ride on horseback.* Others say, that the three first coaches belonged to Catherine de Medici; Diana duchess of Angoulême, the natural daughter of Henry II, who died in 1619 in the eightieth year of her age; and Christopher de Thou, first president of the parliament. The last was excused by the gout; but the rest of the ministers of state soon followed his example.† Henry IV was assassinated in a coach; but he usually rode through the streets of Paris on horseback, and to provide against rain, carried a large cloak behind him. For himself and his queen he had only one coach; as appears by a letter still preserved, in which he writes to a friend, "I cannot "wait upon you to-day, because my wife is using "my coach."‡ We, however, find two coaches at the public solemnity on the arrival of the Spanish ambassador, don Peter de Toledo, under

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* Variétés histor. p. 92.

† Valesiana. Paris 1695. 12mo. p. 35.

‡ Variétés historiques, p. 96.

Mr. Archenholz;* but what he says of the use made of Spanish flies, by the Chinese, to invigorate the sixth sense, gives reason to suspect that his voucher is *L'Espion dévalisé*, to whom the abbé Gagliani ascribes the same words. It appears to me, however, if I may be allowed to judge from

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a lady at Naples who has not some of it lying carelessly on her toilette with her smelling-bottles. She alone knows the phial, and can distinguish it. Even the waiting-woman, who is her confidant, is not in the secret, and takes this phial for distilled water, or water obtained by precipitation, which is the purest, and which is used to moderate perfumes when they are too strong.

" The effects of this poison are very simple. A general indisposition is at first felt in the whole frame. The physician examines you, and perceiving no symptoms of disease, either external or internal, no obstructions, no collection of humours, no inflammations, orders detergents, regimen, and evacuation. The dose of poison is then doubled, and the same indisposition continues without being more characterized.—The physician, who can see in this nothing extraordinary, ascribes the state of the patient to viscous and peccant humours, which have not been sufficiently carried off by the first evacuation. He orders a second—a third dose—a third evacuation—a fourth dose. The physician then sees that the disease has escaped him, that he has mistaken it, and that the cause of it cannot be discovered but by changing the regimen. He orders the waters, &c. In a word, the noble parts lose their tone, become relaxed and affected, and the lungs particularly, as the most delicate of all, and one of those most employed in the functions of the animal œconomy. The first illness then carries you off; because the critical accumulation settles always on the weak part, and consequently on the lobes of the lungs; the pus there fixes itself, and the disease becomes incurable. By this method they follow one as long as they choose for months, and for years. Robust constitutions resist a long time. In short, it is not the liquor alone that kills, it is rather the different remedies, which alter and then destroy the temperament, exhaust the strength, extenuate and render one incapable of supporting the first indisposition that comes."

* England und Italien. ii. p. 354.

probabilities, that the poison known in the East Indies under the name of *powst*, is also water which has stood a night over the juice of poppies. It is given in the morning fasting to those persons, and particularly princes, whom people wish to dispatch privately, and without much violence. It consumes them slowly, so that they at length lose all their strength and understanding, and in the end die torpid and insensible.*

WOODEN BELLOWS.

After the discovery of fire, the first instrument employed to blow it, and strengthen it, has, undoubtedly, been a hollow reed, until the art was found out of forming a stick into a pipe by boring it. Our common bellows, which consist of two boards joined together by a piece of leather, and which probably are an imitation of the lungs, appear to have been early known to the Greeks. I have, however, met with no passage in any ancient author from which I could learn the oldest construction of this machine, which in latter times has received many improvements. Had I found such information, I should have endeavoured to explain it, as it would have contributed to enlarge the

vered with sky-blue velvet, interspersed with golden lilies, a magnificence never before seen by the Neapolitans. At the entrance of Frederic II into Padua, in the year 1239, it appears that there were no carriages, for the most elegantly dressed ladies who came to meet him were on palfreys ornamented with trappings (*sedentes in phaleratis et ambulantibus palafredis*). It is well known that the luxury of carriages spread from Naples all over Italy.*

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* Universal History, xxiii. p. 299. 323.—The information contained there is taken from Fraser's History of Nadir Shaw. Aurengzebe also caused one of his sons to be put to death by this poison.

Coaches were seen for the first time in Spain in the year 1546. Such, at least, is the account of Twiss, who, according to his usual custom, says so without giving his authority.†

Towards the end of the sixteenth century, John of Finland, on his return from England, among other articles of luxury, brought with him to Sweden the first coach.‡ Before that period, the greatest lords in Sweden, when they travelled by land, carried their wives with them on horseback. The princesses even travelled in that manner, and, when it rained, took with them a mantle of wax-cloth.

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* This account is taken from *Observations sur l'Italie et sur les Italiens*, par M. Grosley. London 1774. 4 vol. 12mo. i. p. 326. The author quotes, as his authority, *Scriptores rerum Italicarum*, and *Rollandino Chron.* lib. iv. c. 9.

† Twiss's Travels through Spain and Portugal.

‡ Dalin, Geschichte des reichs Schweden, ubersetzt von Dähnert, iii. 1. p. 390 and 402.

made his countrymen first acquainted with it. However this may be, it is well known that the person who introduces a foreign invention among a people, is often considered as the author of it.

In the oldest smelting-houses the bellows were worked by men. Refuse, therefore, and other remains of metal are found in places where, at present, no works could be erected, on account of the want of water.

Bellows made with leather, of which I have hitherto spoken, are attended with many inconveniences. They require careful management; are expensive in their repairs; and besides last often not more than six or seven years. If thin leather is employed, it suffers a great deal of the air to escape through it: an evil which must be guarded against by continually besmearing it with train-oil, or other fat substances; and this is even necessary when thick leather is used, to prevent it from cracking in the folds. Damage by fire and water must also be avoided; and every time they are repaired, the leather must be again softened with oil, which occasions a considerable loss of time.

In wooden bellows these inconveniences are partly lessened, and partly remedied. As these bellows, except the pipe, consist entirely of wood, many, who are not acquainted with the construction of them, can hardly conceive the possibility of making such a machine. Though they cannot be properly described without a figure, I shall endea-

vour to give the reader some idea of them by the following short sketch. The whole machine consists of two boxes placed the one upon the other, the uppermost of which can be moved up and down upon the lower one, in the same manner as the lid of a snuff-box, which has a hinge, moves up and down when it is opened or shut; but the sides of the uppermost box are so broad as to contain the lower one between them, when it is raised to its utmost extent. Both boxes are bound together, at the smallest end, where the pipe is, by a strong iron bolt. It may be readily comprehended, that when both boxes fit each other exactly, and the upper one is raised over the under one, which is in a state of rest, the space contained by both will be increased; and consequently more air will rush in through the valve in the bottom of the lower one: and when the upper box is again forced down, this air will be expelled through the pipe. The only difficulty is to prevent the air, which forces its way in, from escaping any where else than through the pipe; for it is not to be expected that the boxes will fit each other so closely as to prevent entirely the air from making its way between them. This difficulty, however, is obviated by the following simple and ingenious method. On the inner sides of the uppermost box there are placed moveable slips of wood, which, by means of metal springs, are pressed to the sides of the other box, and fill up the space between them. As

these long slips of wood might not be sufficiently pliable to suffer themselves to be pressed close enough; and as, though planed perfectly straight at first, they would, in time, become warped in various directions, incisions are made in them across through their whole length, at the distance of from fifteen to eighteen inches from each other, so as to leave only a small space in their thickness, by which means they acquire sufficient pliability to be every where pressed close enough to the sides.*

The advantages of these wooden bellows are very great. When made of clean fir-wood without knots, they will last thirty or forty years, and even longer, though continually kept in action forty-six or forty-eight weeks every year: nay, Polhem assures us that, when properly made, they will last a century. The effect produced by them is stronger, as well as more uniform, and can be moderated according to circumstances. They are worked also with greater facility. The slips of wood on their sides are apt to become damaged; but they can soon and easily be repaired. Every three or four months, however, the outer sides only of the

in the use of food.[*] In the casket of Sainte Croix were found sublimate, opium, regulus of antimony, vitriol; and a large quantity of poison ready prepared, the principal ingredients of which the physicians were not able to distinguish. Many have affirmed, that sugar of lead was the chief ingredient;[†] but the consequences of the poison did not seem to indicate the use of that metal. For some years past a harmless plant, which is only somewhat bitter and astringent, the *cymbalaria*, that grows on old walls,[‡] has been loaded with the opprobrium of producing this slow poison, while at the same time it has been celebrated by others on account of its medicinal properties;* but it is, perhaps, not powerful enough to do either mischief or good; and it is probable that it has been added to poisons either through ignorance, or to conceal other ingredients; for the emperor Charles VI, who was king of the Two Sicilies at the time when Toffania was arrested, told his physician Garelli, who communicated the same in a letter † to the celebrated Hoffman, in 1718 or 1719, that the poison of that Italian Circe was composed of an arsenical calx, dissolved in *aqua cymbalariæ*, and which I suppose was rendered stronger and more difficult to be detected by a salt that may be readily guessed. It

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[*] In one year a ton of sand, at least, which is baked with the flour, is rubbed off from a pair of mill-stones. If a mill grinds only 4385 bushels annually, and one allows no more than twelve bushels to one man, a person swallows in a year above six pounds, and in a month half a pound of pulverised sand-stone, which, in the course of a long life, will amount to upwards of three hundred weight. Is not this sufficient to make governments more attentive to this circumstance?

[†] For the following important information I am indebted to professor Baldinger. It is to be found in *Christiani Henrici Erndl Dissert. de veneno salutem sistens*; *resp. T. Taut.* Lipsiæ 1701. § 21. “ There is no doubt that the slow poison of the French and Italians, “ commonly called succession powder (*poudre de la succession*), owes “ its origin to sugar of lead. I know a chemist, who superintends “ the laboratory of a certain prince on the confines of Bohemia, and “ who by the orders (perhaps not very laudable) of his patron, has “ spent much time and labour in strengthening and moderating “ poisons. He has often declared, that of sugar of lead, with the “ addition of some more volatile corrosive, a very slow poison could “ be prepared; which, if swallowed by a dog or other animal, would “ insensibly destroy it, without any violent symptoms, in the course “ of some weeks or months.”

[‡] Antirrhinum cymbalaria. See *Onomatologia medica completa.* Ulm 1753. 8vo. article *Cymbalaria.*

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* J. J. Wepferi Historia cicutæ aquaticæ. Adjectæ sunt dissertationes de thea helvetica ac cymbalaria; curante T. Zwingero. Lugd. Bat. 1733. 8vo.

† Garelli, the emperor's principal physician, lately wrote to me something remarkable in the following words:—" Your elegant dissertation on the errors respecting poisons brought to my recollection a certain slow poison, which that infamous poisoner, still alive in prison at Naples, employed to the destruction of upwards of six hundred persons. It was nothing else than crystallised arsenic, dissolved in a large quantity of water by decoction, with the addition, but for what purpose I know not, of the herb *cymbalaria*. This was communicated to me by his imperial majesty himself, to whom the judicial procedure, confirmed by the confession of the criminal, was transmitted. This water, in the Neapolitan dialect, is called *aqua de Toffnina*. It is certain death, and many have fallen a sacrifice to it." *Fred. Hoffmanni Medicinæ rationalis systematicæ tomus secundus.* Halæ 1729. 4to. p. ii. c. 2. § 19. p. 185.

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is dreadful to think, that this secret poison is administered as a febrifuge by ignorant or unprincipled physicians, quacks, and old women. It drives off obstinate fevers, it is true; but it is equally certain that it hastens death: it is therefore a cure, which is far worse than the disease, and against which governments and physicians cannot exclaim too severely. Let me here be permitted to recommend to the latter the ideas of Mr. Mohsen on this subject,* and to chemists the means Mr. Bell employed to analyse these stygian drops.† It was remarked at Rome, by accident, that lemon juice and the acid of lemons are, in some measure, counter-poisons; and a physician named Paul Branchaletti, respecting whom I can find no information, wrote a book expressly on this antidote to these drops, according to the account of Keysler, who however adds, "Every thing hitherto found out, supposes that one has taken the drops only for a short time, or that one has had an opportunity to be upon one's guard when suspicious circumstances occurred, and to discover the threatened danger."

It seems to be almost certain that the poisons prepared by Toffania and Brinvillier were arsenical mixtures, or, as Dr. Hahneman‡ rightly conjectures, arsenical neutral salts. Loss of appetite, faintness, gnawing pains in the stomach, loss of strength without any visible cause, a continual indisposition, followed by a wasting of the lungs, a slow fever, &c., are all symptoms which seem to announce that dangerous semi-metal. The opinion, however, that it was composed of opium and cantharides has, in latter times, received so many confirmations, that one is almost induced to believe that there are more kinds than one of this stygian water. The information given by the abbé Gagliani seems to carry too much weight with it to be denied.* It is confirmed also by

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* Beschreibung einer medaillen-sammlung, i. p. 148.

† The same, p. 186. Of the internal use of arsenic, see *Baldingers Neue magazin für aerzte*, ii. p. 418.

‡ Ueber die Arsenikvergiftung, ihre hülfe, und gerichtliche ausmittelung. Leips. 1786. 8vo. p. 35.

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* On the 20th of December, 1765, died the dauphin, father of Louis XVI, and in 1767 died the dauphiness. It was a public report that they were both dispatched by secret poison: and the gradual decline of their health, the other circumstances which accompanied their illness, and the cabals which then existed at court, make this at least not improbable. Many private anecdotes respecting these events may be found in a book entitled *L'Espion devalisé. Feliciter audax.* London 1782. In page 61 it is said, that on account of the suspicions then entertained, it was wished that information might be procured respecting secret poison, and the methods of preparing it; and that the abbé Gagliani, well known as a writer, has given the following:—" It is certain that in Europe the preparation of these drugs renders them pernicious and mortal. For example, at Naples the mixture of opium and cantharides, in known doses, is a slow poison; the surest of all, and the more infallible as one cannot mistrust it. At first it is given in small doses, that its effects may be insensible. In Italy we call it *aqua di Tufaniu,* Tufania water. No one can avoid its attacks, because the liquor obtained from that composition is as limpid as rock water, and without taste. Its effects are slow and almost imperceptible: a few drops of it only are poured into tea, chocolate, or soup, &c. There is not

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[*] England und Italien. ii. p. 354.

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name we understand those measurers of time which were used in courts of justice, the clepsydra is a Grecian invention, first adopted at Rome under the third consulship of Pompey.* The most common kinds of these water clocks all, however, corresponded in this, that the water issued drop by drop through a hole of the vessel, and fell into another, in which a light body that floated marked the height of the water as it rose, and by these means the time that had elapsed. They all had this failing in common, that the water at first flowed out rapidly, and afterwards more slowly, so that they required much care and regulation.†

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That ingenious machine, which we have at present under the name of a water clock, was invented in the 17th century. The precise time seems to be uncertain; but had it been before the year 1643,‡ Kircher, who mentions all the then

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* Eloquentiam illud forum magis exercebat, in quo nemo intra paucissimas horas perorare cogebatur, et liberæ comperendinationes erant, et modum dicendi sibi quisque sumebat, et numerus neque dierum neque patronorum finiebatur. Primus tertio consulatu Cn. Pompeius adstrinxit imposuitque velut frænos eloquentiæ. *Auctor dialog. de caus. cor. eloq.* 38.—The orators were confined to a certain time; and hence Cicero says, *latrare ad clepsydram.* TRANS.

† Some account of the writers who have spoken of the water clocks of the ancients may be found in *Fabricii Bibliograph. antiquaria.* p. 1011. They were formerly used for astronomical observations. The authors who treat of them in this respect are mentioned in *Riccioli Almagest. novo,* i. p. 117.

‡ In that year Kircher's *Ars umbræ et lucis* was published for the first time. In the edition of 1671, several kinds of water clocks are described. p. 698.

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these long slips of wood might not be sufficiently pliable to suffer themselves to be pressed close enough; and as, though planed perfectly straight at first, they would, in time, become warped in various directions, incisions are made in them across through their whole length, at the distance of from fifteen to eighteen inches from each other, so as to leave only a small space in their thickness, by which means they acquire sufficient pliability to be every where pressed close enough to the sides.*

The advantages of these wooden bellows are very great. When made of clean fir-wood without knots, they will last thirty or forty years, and even longer, though continually kept in action forty-six or forty-eight weeks every year: nay, Polhem assures us that, when properly made, they will last a century. The effect produced by them is stronger, as well as more uniform, and can be moderated according to circumstances. They are worked also with greater facility. The slips of wood on their sides are apt to become damaged; but they can soon and easily be repaired. Every three or four months, however, the outer sides only of the

inner box, and the bolt which keeps the boxes together, must be smeared with oil. If we reckon up the price of such bellows, and the yearly expence, they will, according to Grignon's account, be only a fifth part of those of the old leather bellows.

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* A complete description and a figure of these bellows may be found in *Schluters Unterricht von hütten-werken.* Brunswick 1738. fol. p. 51; in *Cramers Anfangsgründe der metallurgie.* Blankenburg and Quedlingburg 1777. fol. iii. p. 59; *Mémoires sur l'art de fabriquer le fer, par Grignon.* Paris 1775. 4to. p. 199; *Traité de la fonte des mines par le feu du charbon de terre*; par M. de Genssane. Paris 1770. 2 vol. 4to. i. p. 96; *Pini de venarum metallicarum excoctione.* Vindobonæ 1780. 4to. vol. i. p. 107.

That the invention of these wooden bellows belongs to the Germans, is certain. Grignon* expressly affirms so; and in Becher's† time they were to be found in Germany, but not in England. Genssane, who ascribes the invention to the Swiss, is certainly mistaken; and perhaps he was led into this error, because these bellows were first made known in France by a Swiss. I cannot, however, ascertain the name of the real inventor. In the middle of the sixteenth century lived at Nuremberg an artist called Hans Lobsinger, who, in the year 1550, gave to the magistrates of that city a catalogue of his machines. From this catalogue Doppelmayer concludes that he understood the art of making small and large bellows without leather, and entirely of wood, which could be used in smelting-houses and for organs, and likewise copper bellows that always

emitted a like degree of wind. As Lobsinger made organs, he, perhaps, fell upon this invention: but in what it actually consisted, or whether it might not die with him, I have not been able to learn. Agricola, who died in the year 1555, makes no mention of wooden bellows.

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* Germany is the country of machines. In general the Germans lessen manual labour considerably by machines adapted to every kind of movement; not that we are destitute of able mechanics; we have the talent of bringing to perfection the machines invented by our neighbours. P. 200.

† Bechers Narrische weisheit und weise narrheit. Frankfort 1683. 12mo. p. 113.

Samuel Reyher, formerly professor at Kiel, in a dissertation on air,* printed there in 1669, tells us, that about forty years before that period, two brothers, Martin and Nicholas Schelhorn, millers at the village of Schmalebuche in Cobourg, first invented wooden bellows. Both the brothers, he says, kept the invention secret, though he thinks they did not conceal it so closely as to prevent its being guessed at; and he relates also how he himself formed an idea of it.†

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* In this dissertation, the time of the invention is stated to be about forty years before, which would be the year 1629 or 1630; but in an improved edition, printed with additions at Hamburg, in 1725, and entitled *De pneumatica, sive De aëre et aërometria*, a different period is given. "About eighty years ago," says the author, "a new kind of "bellows, which ought rather to be called the pneumatic chests, was "invented in the village of Schmalebuche, in the principality of Co- "bourg, in Franconia. Two brothers, millers in that village, Martin "and Nicholas Schelhorn, by means of some box made by them, the "lid of which fitted very exactly, found out these chests, as I was "told by one of their friends, a man worthy of credit. These chests "are not of leather, but entirely of wood joined together with iron "nails. In blacksmiths' shops they are preferred to those construct- "ed with leather, because they emit a stronger blast, as leather suf- "fers the more subtile part of the air to escape through its pores."

† In many places these bellows were at first put in a wooden case, to prevent their construction from being known.

imagined that they smelt the fabulous origin of the lyncurium.

Less ridiculous is the opinion of some old and modern writers, that the lyncurium was a species of amber. Theophrastus, however, the ablest and most accurate mineralogist of the ancients, would certainly have remarked this, and not have separated the lyncurium from amber. Besides, the latter has not the hardness of the former, nor can it be said that it is difficult to be cut; for, at present, it is often made into various toys with much ingenuity. The opinion of Pliny is here of little weight; for it is founded, as ours must be, on the information of Theophrastus.

Epiphanius, who considered the Bible as a system of mineralogy, but could not find the lyncurium in it, supposes that it may have been the hyacinth.* However ridiculous the cause of this conjecture may be, it must be allowed that it is not entirely destitute of probability; and I say with John de Laet, "The description of the lyncurium does not "ill agree with the hyacinth of the moderns." † If we consider its attracting of small bodies in the same light as that power which our hyacinth has in common with all stones of the glassy species, I cannot see any thing to controvert this opinion,

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* Epiphanius de xii gemmis.

† J. de Laet de gemmis. Lugduni Bat. 1647. 8vo. p. 155. Sane descriptio lyncurii non male convenit cum hyacintho neotericorum.

COACHES.

If by this name we are to understand every kind of covered carriage, in which one can with convenience travel, there is no doubt that some of them were known to the ancients. The *arcera*, of which mention is made in the twelve tables, was a covered carriage used by sick and infirm persons.* It appears to have been employed earlier than the soft *lectica*, and by it to have been brought into disuse. A later invention is the *carpentum*, the form of which may be seen on antique coins, where it is represented as a two-wheeled car, with an arched covering, and which was sometimes hung with costly cloth.† Still later were introduced the *carrucæ*, first mentioned by Pliny; but so little is known of them, that antiquaries are uncertain whether they had only one wheel, like our wheel-barrows, or, as is more probable, four wheels.‡ This much, however, is known, that they were first-rate vehicles, ornamented with gold and precious stones, and that the Romans considered it as an

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* Arcera vocabatur plaustrum tectum undique et munitum, quasi arca quædam magna vestimentis instrata, qua nimis ægri aut senes portari cubantes solebant. See Leges XII. tabularum illustratæ a J. N. Funccio. Rintelii 1744. 4to. p. 72. Gellius, xx. 1.

† Scheffer de re vehiculari, in Utriusque thesauri antiquitatum nova supplementa congesta a Poleno. Venetiis 1737, fol. v. p. 1380. Spanhem. de præstant. numismatum. Amst. 1671. 4to. p. 613. Propertius, iv. 8. 23. mentions *serica carpenta*.

‡ Scheffer, l. c. p. 1472.

With much greater probability may we consider as the turmalin a precious stone, classed by Pliny among the numerous varieties of the carbuncle;* for, however perplexed and unintelligible his account of the carbuncles may be, and however much the readings, in the different copies, may vary, we still know that he describes a stone which was very hard; which was of a purple, that is a dark violet colour, and used for seals, and which when heated by the beams of the sun, or by friction, attracted chaff and other light bodies. Had Pliny told us that it at first attracted and then repelled them, no doubt would remain; but he does not say so, nor do his transcribers Solinus and Isidorus.†

A much later account of a stone that, when rubbed, is, like the magnet, endued with an attractive power is to be found in a passage of

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* Et inter has invenio differentiam; unam quæ purpura radiat; alteram quæ cocco; a sole excalfactas, aut digitorum attritu, paleas, et chartarum folia ad se rapere. Hoc idem et carchedonius facere dicitur, quamquam multo vilior prædictis. So reads Harduin; but Saumaise, from the authority of manuscripts, says the passage ought to run thus: Et inter has invenio differentiam. Una purpura radiat, altera cocco. A sole excalefacta, aut digitorum attritu, paleas et chartarum fila ad se rapit. *Plin.* lib. xxxvii. c. 7.

† India produces also the lychnites, the splendor of which is heightened when seen by the light of lamps; and on this account it has been so called by the Greeks. It is of two colours; either a bright purple, or a clear red, and if pure is thoroughly transparent. When heated by the rays of the sun, or by friction, it attracts chaff and shavings of paper. It obstinately resists the art of the engraver. *Solinus*, c. lii. p. 59. ed. Salmasii. Trajecti ad Rhenum 1689. fol.

John Serapion, the Arabian, pointed out to me by professor Butner.* This stone, indeed, cannot with much probability be taken for the turmalin, as all precious stones, when heated, have the same property; but it is worthy of remark, that, like the lyncurium of the ancients, it belongs to the hyacinths, the colour of which many of the real turmalins have; and among those of the island of Ceylon there are, perhaps, some which ought to be classed among the hyacinths, rather than among the shirls.

The real turmalin was first brought from Ceylon, and made known by the Dutch, about the end of the seventeenth or beginning of the eighteenth century. It is commonly believed, that the first account of it ever published is that to be found in the Memoirs of the Academy of Sciences at Paris, for the year 1717; but it appears, that fuller and more accurate descriptions of the properties of that stone were given in German works ten years before. The earliest information that I know respecting it is in a book, now almost and justly forgotten, entitled *Curious speculations during sleepless nights.** In a passage, where the author, speaking of hard and glassy bodies which attract light substances, affirms that this property is not magnetic, he says, "the ingenious Mr. Daumius, chief physician to the Polish and Saxon troops on the Rhine, told me, that in the year 1703 the Dutch first brought from Ceylon in the East Indies a precious stone called turmalin, or turmale, and named also *trip*, which had the property, that it not only attracted the ashes from the warm or burning coals, as the magnet does iron, but also repelled them again, which was very amusing; for as soon as a small quantity of ashes leaped upon it, and appeared as if endeavouring to writhe themselves by force into the stone, they in a little sprang from it again, as if about to make a new effort; and on this account it was by the Dutch called the *ashes-drawer*. The colour of it was an orange red heightened by a fire colour. When the turf coals were cold, it did not produce these ef-

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* Hager albuzedi is a red stone, but less so than the hyacinth, the redness of which is more agreeable to the eye, as there is no obscurity in it. The mines where this stone is found are in the East. When taken from the mine it is opaque; but when divested of its outer coat by a lapidary, its goodness is discovered, and it becomes transparent. When this stone has been strongly rubbed against the hair of the head it attracts chaff, as the magnet does iron. *Joan. Serapionis Lib. de simplicibus medicinis.* Edit. Othonis Brunfelsii. Argentorati 1531. fol. p. 263.

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* Curiose speculationes bey schlaf-losen nächten, von einem liebhaber der immer gern speculirt. Chemnitz und Leipzig, bey Conr. Stösseln, 1707. 857 pages in octavo. The author's name, which I am not able to conjecture, appears to be expressed by the initials I. G. S. This work consists of forty-eight dialogues, each twelve of which have a distinct title. Brückman quotes it in *Magnalia Dei*, p. 302.

" fects, and it required no care like the magnet. I " have considered whether it would not attract and " repel the ashes of other burning coals as well as " those of turf; and I have no doubt, that, if heat- " ed, it would attract other things besides ashes."

This whole passage has been inserted word for word, without variation or addition, and without telling the source from which taken, in a book, perhaps equally forgotten; called *Observationes curioso-physicæ, or Remarks and observations on the great wonders of the world,* by Felix Maurer, physician and philosopher.* This thick volume is entirely compiled from a number of works, the names of which are not mentioned.

In the catalogue of the collection of natural curiosities belonging to Paul Hermann, which were sold at Leyden in June 1711, I find, among the precious stones, *Chrysolithus Turmale Zeylon.*† Though no description is added, it cannot be doubted that our turmalin is here meant. From this, however, we learn that the name together with the stone came to us from Ceylon, as Watson has remarked, and that we ought not to write it *tourmaline,* after the French. We learn further, that the stone was at first considered as a chrysolite, and perhaps it may be mentioned under this name in the old accounts of Ceylon. Hermann, whose service to botany is well known, was in that island from 1670 to 1677; and it might be presumed, from his spirit of inquiry, that, had he known this stone, he would somewhere or other in his works have taken notice of its properties: but I find no mention of it either in his *Cynosura materiæ medicæ*,* or in *Musæum Zeylonicum.*†

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* Frankf. und Leipzig bey Buggeln, in Nürnberg 1713. 8vo. 1039 pages.

† Catalogus muſei Indici collecti a P. Hermanno. Lugduni Bat. 8vo. 52 pages.

In the year 1719 the Academy of Sciences at Paris announced in their memoirs for 1717, that in the latter year Mr. Lemery had laid before them a stone found in a river in the island of Ceylon, which attracted and repelled light bodies.‡

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* Argentorati 1726. 4to.

† Edit. sec. Lugduni Bat. 1726. 71 pages 8vo. This work is only a catalogue of the plants of Ceylon, with the English names, published by William Sherard, which Haller has not remarked in his Biblioth. Bot. ii. p. 16.

‡ I shall here lay before the reader the whole passage, taken from *Histoire de l'Académie* for 1717, p. 7. Here we have a small magnet. It is a stone found in a river of the island of Ceylon. It is of the size of a denier, flat, orbicular, about the tenth part of an inch in thickness, of a brown colour, smooth and shining, without smell and without taste, which attracts and afterwards repels small light bodies, such as ashes, filings of iron, and bits of paper. It was shown by Mr. Lemery. It is not common, and that which he had cost twenty-five livres (about twenty shillings sterling). When a needle has been touched with a loadstone, the south pole of the loadstone attracts the north pole of the needle, and repels its south pole: thus it attracts or repels different parts of the same body, according as they are presented to it, and it always attracts or repels the same. But the stone of Ceylon attracts, and then repels in the like manner, the same small body presented to it: in this it is very different from the loadstone. It would seem that it has a vortex. - - -

It is there called a small magnet, though some difference between the two stones was admitted; but the German naturalist, before mentioned, denies that the turmalin is endowed with magnetic virtue. It is however very remarkable, that though it is said, in the Memoirs of the Academy, that it has the power of attracting and repelling, no mention is made that it acquires that property, only after it has been heated, which is expressly remarked by the German. Those, therefore, who wish to ascribe to the ancients a knowledge of the turmalin may say, If the editor of the Memoirs of the French Academy could forget this circumstance, is it not highly probable that Theophrastus might have forgot it, in describing the lyncurium; Pliny, in describing the carbuncle; and Serapion, in describing his hyacinth?

After this period the turmalin must have been very scarce in Europe; for when Muschenbroek made his well-known experiments with the loadstone, and spared no labour to carry them to the utmost extent, he was not acquainted with the nature of the turmalin, which, according to the account given of it by the Academy at Paris, he considered as a magnet, as he himself says in the preface to his first dissertation, published in 1724.*

About the year 1740, however, some German naturalists made experiments with this stone, in order to discover the real cause of its attractive property. These may be seen, under the article *Trip*, in the well-known Dictionary of Natural History which is often printed with Hubner's preface; but I do not know to whom the honour belongs of having first investigated the properties of this stone. As the above dictionary is common, I shall give here only a very short extract from it. "This stone was brought to Holland by some persons who had travelled in India, from the island of Ceylon, where it is found, pretty frequently, among the fine sand, near Columbo, and sold to the German Jews. These caused it to be cut thinner, and the price of it soon rose to eight and ten Dutch florins. It has been since much dearer; but at present it is cheaper. It attracts not only ashes, but also metallic calces: it however attracts more easily and with greater force those which have been formed by means of sal ammoniac, or the spirit of that salt. It acquires its attractive power only after it has been moderately heated; for when cold or heated to a greater degree it produces no effect, which the author ascribes to its being united with martial sulphur. The chrysolites and other precious stones of the island do not possess the same property." As the author quotes the *Laboratorium Zeylonicum*,* I consulted it, but found no information in it respecting the turmalin. The first person who thought of explaining the property of the turmalin by electricity was the great Linnæus, who, in the preface to his *Flora Zeylanica*,* where he enumerates the productions of the island, calls it the electrical stone; but at that time, as he himself afterwards told me, he had not seen it.

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* The magnet of the island of Ceylon, described by the learned academicians of Paris, I have not yet examined. *Dissertationes physicæ experimentales.* Viennæ 1756. 4to. p. 10.

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* Insulæ Ceyloniæ thesaurus medicus, vel Laboratorium Ceylonicum, a Pielat latinitate donatum. Amstelod. 1769. 12mo. The

What Linnæus only conjectured, Mr. Æpinus proved at Berlin, in 1757, by accurate observation and experiments, when endeavouring with Mr. Wilke to investigate the secret of negative and positive electricity. The history of their discoveries I shall here omit, as a better account of them than I could give has been published in the Transactions of the Swedish Academy† by Mr. Wilke, to whom the public are indebted for, perhaps, the best elucidation of the laws of the electricity of turmalin.

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author, whose name is not mentioned by the illiberal translator, was H. N. Grimm, a Swede.

* I must not omit to mention that the rivers contain the electric stone, which is of the size of a halfpenny, flat, orbicular, shining, smooth, of a brown colour, one tenth of an inch in thickness, without smell and without taste, and which attracts light bodies, such as ashes, filings of iron, shavings of paper, &c. and afterwards repels them. A wonderful and singular property, discovered and observed in this stone alone, when neither heated by motion nor by friction. *Flora Zeylanica.* Holmiæ 1747. 8vo. p. 8.

† In the German translation, xxviii. p. 95. xxx. pp. 1 and 105.

SPEAKING-TRUMPET.

INSTRUMENTS by which the voice could be so strengthened as to be heard at a much further distance than would otherwise have been possible, were known in the earliest ages; for of all musical instruments, wind instruments were first invented, and their use in war, to give the signal of battle, we find mentioned in Job.* It had been remarked, even in Pliny's time, that the least touching of a beam of wood could be heard when one placed one's ear at the other end.† It was known, likewise, that the larger trumpets were, they emitted a louder and stronger sound. The Grecians had a wind instrument with the bellowing noise of which the people who were placed to guard the vineyards frightened away the wild animals.‡ All these wind instruments, however, were little in comparison of the monstrous trumpets of the ancient Chinese, a kind of speaking-trumpets, or instruments by which words could not only be heard at the greatest distance possible, but could be also understood.* This invention belongs to the 17th century, though some think that traces of it are to be found among the ancient Grecians.

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* Goguet, l'Origine des loix et des sciences chez les anciens peuples.

† Ideo fit ut, aure ad caput trabis quamlibet prælongæ admota, ictus ab altero capite vel graphii sentiatur, penetrante rectis meatibus sono. *Plin.* lib. xvi. c. 38. ii. p. 32.

‡ Si quis in amphoræ urceolo, aut angusta illa parte quam amphoræ collum dicimus, impellat vi et impetu aerem et expellat, sonum producet horridum, ac timorem belluis incutientem: tali instru-

Kircher, as far as I have been able to learn, was the first person who made known, from a very ancient manuscript of Aristotle, *De Secretis ad Alexandrum Magnum*, preserved in the Vatican, that Alexander had a prodigious large horn with which he could assemble his army at the distance of a hundred stadia, or eight Italian miles. It was, according to the manuscript, five cubits in diameter; and Kircher, who gives a figure of it, which he says he found in the manuscript, thinks that, on account

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mento custodes vinearum et fructuum ad avertendas belluas utuntur. *Septalii Commentaria in Aristotelis problemata.* Lugduni 1632. fol. p. 206. lib. xxv. prob. 2. To the same purpose is the following passage of Seneca, pointed out to me by professor Hollman, and which almost seems to allude to a speaking-trumpet: Nam quemadmodum spiritus noster clariorem sonum reddit, cum illum tuba per longi canalis angustius tractum, patentiore novissime exitu effudit; sic sensus nostros clariores carminis arcta necessitas efficit. *Epist.* 108.

* See Anciennes relations des Indes et de la Chine, de deux voyageurs Mahometans, qui y allèrent dans le neuvième siècle. Par Renaudot. Paris 1718. 8vo. p. 25. These large trumpets are by Haller in his *Elementa physiologiæ*, vol. v. Lausannæ 1763, 4to, p. 263, improperly called speaking-trumpets.

of its size, it must have been suspended from a beam by a ring. This horn has by many been considered as the oldest speaking-trumpet;* but in my opinion, without reason. *Aristotelis Secretum Secretorum ad Alexandrum Magnum* I have never had an opportunity to see. It appears to have been printed only once, and is, like all the other works ascribed to that philosopher, extremely scarce; for they have all had the fate of being little regarded after it became the unanimons opinion of the learned that they were forged. These works, however, are old; some of them indeed very old: and, if one should take the trouble to fix their antiquity, they might be used with advantage on many occasions. Morhof had in his possession the edition of that book published by Alexander Achillinus, a physician at Bologna, in 1516, which is a Latin translation from the Arabic.* If we compare what is said there and by Kircher, we may make the following conclusion:

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* Ars magna lucis et umbræ. Amstelodami 1671. fol. p. 102. Kircher repeats this account with some new circumstances in his *Phonurgia*, p. 132. Aguntur jam cumplura lustra, quibus in bibliotheca Vaticana, hieroglyphicum agens Oedipum, casu inciderem in librum cui titulus erat, Secreta Aristotelis ad Alexandrum Magnum; ubi inter cætera de cornu prodigioso Alexandri M. hæc leguntur: Faciebat hoc cornu adeo vehementem sonum, ut eo exercitum suum ad centum stadia (quorum octo unum milliare Italicum conficiunt) dispersum convocasse perhibeatur; habebat autem, ut libellus monstrat, quinque cubitos in diametro; et fulcri suspendebatur annulo, uti ego reor, cujus tamen figuram non describit. Figuram hic appono, prout in dicto libello impressam reperi, cum epigraphe: Cornu Alexandri Magni. It would appear from what Kircher here says, that he had seen the book printed; but in the first quoted work he says expressly, *Reperi in antiquissimo codice.*

In the first place, it is certain that the book itself, as well as the whole account, is not the production of Aristotle; for in all the writers who relate the actions of Alexander we do not find the least mention of such a horn. Secondly, it is not expressly said in that work, that Alexander spoke through this horn; but only that he assembled his soldiers by it, which in past times was done by the sound of a trumpet, and at present is done both by trumpets and drums. It appears also that the author of the book, perhaps an Arabian, intended to give the reader an idea of a horn that had an uncommonly strong and loud sound. Thirdly, Kircher's account and figure of the horn do not agree with that which Morhof found in the edition of Achillinus.† Lastly, none of these descriptions are such, that an instrument to serve as a speaking-trumpet could be constructed from them.

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* Morhofii Diss. de vitro per vocis sonum rupto, in Dissertationibus academicis. Hamburgi 1669. 4to. p. 381. See also Fabricii Biblioth. Græca, vol. ii. b. 3. p. 167.

† Morhof quotes from the book the following passage: Hoc æneo cornu mirabili artificio fabricato Alexander rex magnificus ex lx. milliaribus exercitum suum convocavit. Quod ob illius inæstimabile artificium et excedentem magnitudinem lx. viris regebatur. Verum multa resonantium metallorum genera in ejus compositionem concurrebant. *With this brazen horn, constructed with wonderful art, Alexander the Great called together his army at the distance of sixty miles. On account of its inestimable workmanship and monstrous size, it was under the management of sixty men. Many kinds of sonorous metals were combined in the composition of it.*

Wolf and other mathematicians are of opinion that the most advantageous form of a speaking-trumpet would be found with more certainty by experience than by theory. It may then be asked, whether any one ever caused such an instrument to be made from these descriptions. Kircher, who attempted things much more improbable, says he never tried it. Duhamel, however, relates that a Frenchman tried it, and discovered the real instrument:* but this information is of little weight, as it is much to be doubted that this Frenchman caused it to be made sufficiently exact according to the ancient description. I am as little acquainted with Bettini as Morhof; but I suspect that Duhamel meant Mar. Bettini, who, without making the smallest mention of Alexander's horn, proposes only a tube, the one end of which should be applied to the mouth of a person who speaks, and the other to the ear of one who is dull of hearing.* This was rather an ear-trumpet than a speaking-trumpet, and it is certain that the former was invented before the latter.

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* Among many things which the celebrated D'Alance caused to be made for this purpose, that trumpet ascribed to Alexander, and with which he called together his army, ought not to be omitted. As the figure of it was represented in an old manuscript in the Vatican library, and had been described by Bettini, that learned man was desirous of trying whether it could be proved by experience, and the attempt succeeded; for that kind of trumpet, if it does not excel, seems undoubtedly to equal the other instruments constructed for that end. *De corpore animato*, lib. ii. cap. 4. in *Joh. Bap. du Hamel, Opera philosophica*. Norimbergiæ 1681. 2 vol. 4to. ii. p. 560.

What we read in Porta, and what many think alludes to a speaking-trumpet, alludes evidently to an ear-trumpet only. That author infers, very justly, from the form of the ear, and particularly from that of the ears of those animals which are quick of hearing, that to hear at a distance one must apply to the ear a kind of wide funnel, as people to strengthen the sight use spectacles.† He asserts also, with equal truth, that one, through a long tube, can convey a whisper to the ear of another person at a very great distance;‡ an experiment which he himself made at the distance of two hundred paces. Schwenter, who wrote before the speaking-trumpet was known, proposes, from the hint of Porta, an ear-trumpet one end of which should be applied to the ear.*

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* Apiaria universæ philosophiæ mathematicæ, auctore Mario Bettino. Bononiæ 1642. fol. Apiarium decimum, pag. 38.

† Magia natural. lib. xx. c. 5. p. 653.

‡ To communicate any thing to one's friends by means of a tube. This can be done with a tube made of earthen-ware, though one of lead is better, or of any other substance, but very close, that the voice may not be weakened; for whatever you speak at the one end, the words issue perfect and entire as from the mouth of the speaker, and are conveyed to the ears of the other; which, in my opinion, may be done for some miles. The voice, neither broken nor dispersed, is carried entire to the greatest distance. We tried it at the distance of two hundred paces, not having convenience for a greater; and the words were heard as clearly and distinctly as if they had come from the mouth of the speaker. Lib. xvi. c. 12. p. 568.

Respecting the invention of the speaking-trumpet, Sir Samuel Morland an Englishman, and the jesuit Kircher, have, in latter times, contended. The former, in 1671, published a particular description of one, after he had made many experiments upon it the year preceding. This instrument, shaped like a wide-mouthed trumpet, he caused first to be constructed of glass, and afterwards of copper, with various alterations, and performed several experiments with it in presence of the king, prince Rupert, and other persons, who were astonished at its effects.†

As an account of this discovery was soon spread all over Europe, Kircher asserted, that he had constructed speaking-trumpets before Sir Samuel Morland, and supported his assertion by referring to his former writings; and by the testimony of other authors. I shall first take notice of the former. His *Ars magna lucis et umbræ* was first printed in 1643. I at least conclude so, because, in the preface to his *Phonurgia*, printed in 1673, he says, that work had been published thirty years before. The second edition is of 1671, in which I find only the already quoted passage respecting Alexander's horn, and the figure of a tube which, like that proposed by Bettini, should be applied to the ear of a person who hears, and to the mouth of the speaker. The *Musurgia*, printed in 1650, contains better grounds for supporting the assertion of Kircher.* In the second part he describes how a funnel can be placed in a building in such a manner, that a person in an apartment where the narrow end is introduced can hear what is spoken without the building, or in another apartment, where the wide end may be. To this description a figure is added, and the author acknowledges he was led to that idea by the construction of a well-known building of Dionysius.†

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* Mathematische erquickstunden, i. p. 243.

† An account of the speaking-trumpet, as it hath been contrived and published by Sir Samuel Morland, knight and baronet, together with its use both at sea and land. London 1671. An extract from it may be seen in the Philosophical Transactions, No. 78. page 3056. A complete translation was printed in *Recueil des mémoires et conférences sur les arts et les sciences, pendant l'année* 1672, par J. B. Denis.

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* Musurgia universalis, sive Ars magna consoni et dissoni. Romæ 1650. fol. p. 303.

† Among the antiquities of Syracuse, in Sicily, one beholds with wonder chambers and galleries which are hewn out in the solid rock, and particularly a grotto, from which arises a winding passage, that becomes upwards still narrower. Ancient tradition says, that this was a prison, which the celebrated tyrant Dionysius caused to be built for state prisoners, that in an apartment of his palace, which stood over the narrow end of the passage, he might hear every thing the prisoners said, or what plots they formed against him. This grotto, therefore, is called *Orechio di Dionysio*, or *la grotta della Favella*; *auris Dionysii*, the ear of Dionysius. Many travellers and others formerly imagined that this passage was an ingenious imitation of that part of the human ear called the helix; which was first remarked by Alcmaon the Pythagorean. This is the account given

He does not, however, say expressly that he had ever tried the experiment; but in the last page of

by Kircher, who was there in the year 1638. See his ***Phonurgia,*** page 82, where there is a figure of it. In later times, however, this grotto has been examined with more skill and acuteness by people less subject to prejudice, and since that period the supposed wonder has been lessened. The rock consists of lime-stone, at least I conclude so from what is said by Brydone, who found it every where full of cracks and fissures. The stones of which Syracuse was built were hewn from the rock; and hence have been formed these chambers or openings, like those found in the neighbourhood of other ancient and modern cities, such as Rome, Naples, and Maestricht. Many of these, in the course of time, have been employed as prisons, or used as burying-vaults. The above-mentioned passage, which has excited so much wonder, is not properly spiral, and is of such a figure that it may have been produced either by accident, or through the whim of the workmen employed to hew out the stones. The double echo, which Kircher assures us he heard in the grotto, was not remarked by Schott, who was there in 1646, as he expressly says, in opposition to his brother jesuit, in his *Magia naturalis.* In the accounts still remaining of Dionysius we find mention of an astonishing prison, which is well described by Cicero, in his fifth oration against Verres: "You have all heard of," says he, "and most "of you know the prison (lautumias) of Syracuse. It is an immense and magnificent work, executed by kings and tyrants; the "whole is sunk to a wonderful depth in the rock, and has been entirely cut out by the labour of many hands. No place so secured "against an escape; no place so enclosed on all sides; no place so "safe for confining prisoners can be either planned out or constructed." But it cannot be proved, and according to D'Orville's opinion it is improbable, that this grotto was the work of that tyrant, who, as Plutarch tells us in his Life of Dion, employed very different means to learn the intention of dangerous persons. "The common people attacked the tyrant's friends, and seized those whom "they called his emissaries (προσαγωγίδας), worthless men, detested "by the gods. These went about the city, mixed with the citizens, and, prying into every thing, gave an account to the tyrant the preface to the *Phonurgia*, he pretends that so early as the year 1649 he had caused such a machine to be fixed up in the Jesuits' college. But, supposing this to be true, it can only be said that he then approached very near to the invention of the speaking-trumpet, by an instrument, which, in reality, however, was calculated to strengthen the hearing, and not the voice; and therefore only the half is true of what he advanced in his preface in 1673, that twenty years before he had described in his *Musurgia* the trumpet invented in England.

In the *Phonurgia*,* however, written after Morland's publication was every where known, Kircher certainly treats of the speaking-trumpet, and says that, from the similarity of the progress of

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"of what they thought, and what expressions they made use of." It was merely for its strength, and the labour employed in building it, and not on account of its ingenious construction, that the ancients admired the prison of the tyrant. At present, the upper end of the winding passage is closed up; and it is so narrow, that, some years ago, the captain of an English vessel found great difficulty to clamber up it. It cannot, however, be denied that this grotto may have been used for the service ascribed to it; and I can readily believe that it may have led Kircher to the invention of the ear-trumpet.—See Travels by Peter de la Valle, Ray and Brydone; *Delle antiche Siracuse volume primo, che contiene i due libri da G. Bonanni—volume secondo, che contiene gli scrittori anteriori a Bonanni.* In Palermo 1717. fol. *Daniel Bartolo del suono e de' tremori harmonici.* Bonon. 1680, who examined this grotto as a naturalist. *J. P. D'Orville, Sicula.* Amstelodami 1764. 2 vol. fol. i. p. 182. 194.

* Phonurgia nova. Campidonæ 1673. fol.

sound to that of the rays of light, he was led to the idea of conveying the former, in the same manner as the latter, to a great distance, by means of an instrument. For this purpose, about twenty-four years before, he had caused to be constructed, in the Jesuits' college at Rome, an ear-trumpet, through which the porter could communicate any thing he had to say to him, when he was in his apartment in the upper story. This apparatus attracted the notice of many strangers, who were astonished at its effect. He here represents it as a proper speaking-trumpet; and adds, that it excited much surprise, on account of the uncommon strength which it gave to the voice. For this reason he was very desirous of trying to what distance words could be distinctly conveyed by such a tube; and an opportunity occurred of doing this the same year that he wrote his *Phonurgia*. From a convent, situated on the top of a mountain, he assembled twelve hundred persons to divine service, at the distance of from two to five Italian miles, and read the Litany through it. Soon after, the emperor caused a tube to be made according to Kircher's description, by which, without elevating the voice, he could be understood from Ebersdorf to Neugebeu. But, though Kircher came so near to the invention of the speaking-trumpet, it does not appear certain by his works that he attempted or constructed it before Sir Samuel Morland. I shall now examine the evidences he adduces in his favour.

The most important of these is Schott, because he published his *Magia Naturalis** in 1657, before the invention of Sir Samuel Morland. All that is to be found in this work, however, relates alone to the ear-trumpet; a figure of which is added from the *Musurgia;* but we here learn, with certainty, that Kircher then had the before-mentioned funnel or tube in his apartment. It is also not improbable that he had tried to answer the porter from his apartment, and that he had thereby remarked that the voice was strengthened; for it is not proved by Schott that he at that time was acquainted with and had in his possession a portable speaking-trumpet.

Another author by whom Kircher endeavours to support his claim is Harsdorfer; who, however, speaks only of tubes to be closely applied to the mouth and to the ear, and who refers to the *Mus-*

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* This machine was invented by Kircher, in imitation of the Ear of Dionysius; nor is it a vain and empty speculation, for the machine produces an infallible effect. Kircher caused to be made at Rome, of tin plate, a very large and straight tube, like a funnel, and placed it in an apartment next to his chamber, in such a manner that the large end projected into the garden of the college, and the less entered his chamber. When the porter of the college had occasion to call him to the gate, that he might not be obliged always to go up stairs, or to bawl out, he went to the broad end of the funnel, and communicated what he wished to Kircher. *Schotti Magia universalis naturæ et artis.* Herbipoli 1657—1659. 2 vol. 4to. ii. p. 156.

urgia, without mentioning the real speaking-trumpet, though the second part of his Mathematical Recreations was first printed in 1677, and the third in 1692.* Besides these testimonies, Kircher quotes also Eschinard concerning sound.† With that work I am not acquainted; but as the information it contains is taken from the *Musurgia*, it is of as little importance as that of Derham,‡ who refuses the invention to his countryman, and gives it to Kircher. When I unite all the evidence in favour of Kircher, it appears to be certain that he made known and employed the ear-trumpet earlier than the portable speaking-trumpet; that he, however, approached very near to the invention of the latter, but did not cause one to be constructed before Sir Thomas Morland, to whom the honour belongs of having first brought it to that state as to be of real use. Such, at least, is the manner in which this dispute is decided by the Jesuit De Lanis.§

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* Vol. ii. p. 152. and iii. p. 362.

† Eschinardi Discursus de sono pneumatico, p. 10.

‡ Physico-theology.

§ Our Kircher, in his *Phonurgia*, justly claims that invention, as it was several years ago exhibited by him in the Jesuits' college at Rome, and an account of it printed. That this is true I myself was an eye-witness; though I must acknowledge that no one before the above-mentioned Englishman ever applied this speaking instrument, at least in so perfect a manner, to that use for which it was afterwards employed. *Magisterium naturæ et artis.* Brixiæ 1684—1692. fol. ii. p. 436.

When Morland's invention was made known in France, it was pretended that Salar, an Augustine monk, had seven or eight years before caused such tubes or trumpets to be made, in order to strengthen the voice of a weak bass singer; but he himself acknowledges that he never had an idea of speaking with them at a distance.[*]

This instrument was soon made for sale at Nuremberg, in Germany, particularly by that well-known artist Grundler, mentioned by Becher,[†] who imagined that two persons, by means of a speaking-trumpet and an ear-trumpet, could converse together at a great distance, without any one in the neighbourhood, or in the intermediate space, hearing what they said.

Of those who employed their ingenuity in improving this instrument I shall mention the following. Cassegrain, known on account of his optical instruments, published some hints for that purpose in 1672;[‡] as did Sturm,[§] Conyers,[||] Hase, and others afterwards.[¶] The last who investigated the theory of the speaking-trumpet was

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[*] Journal des sçavans, tome iii.

[†] Narrische Weisheit, p. 37.

[‡] Journal des sçavans, ut supra, p. 131.

[§] J. A. Sturm, Collegium experimentale sive curiosum. Norimbergæ 1701. 4to. ii. p. 146.

[||] Philosoph. transact.

[¶] Dissert. de tubis stentoreis. Lipsiæ 1719.

Lambert;* according to whose ideas the figure of a shortened cone, if not the best, is at least as good as any other that might be employed.

ANANAS.

To discover the excellence of the ananas required no great skill in botanical physiognomy. It recommended itself so much by its taste, smell, and colour, as to attract the notice of the first Europeans who visited Brasil; and we find it praised in the earliest writers on America, who give an account of it, as well as of tobacco, maize, and other productions of the new world.

Gonçalo Hernandez de Oviedo is, as far as I know, the first person who described and delineated the ananas. This author was born at Madrid in 1478; went to America in 1513, and in 1535 was governor of St. Domingo. In the last-mentioned year, his General History of America was printed at Seville. At that time three kinds were known, which in America were called *yayama*, *boniama*, and *yayagua*, but by the Spaniards *pinas*. Attempts had then been made to send the fruit to

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* Mémoires de l'Académie des Sciences à Berlin, année 1763, p. 87. Compare also De la Chapelle's Treatise on conic sections, translated into German, with observations, by J. L. Bockmann. Carlsruhe 1771. 8vo. p. 217.

Spain by pulling it before it was ripe; but it had always become spoilt in the course of the voyage. Oviedo had tried also to send slips or young shoots to Europe, but these also died by the way. He, however, entertained hopes that means would be found to rear the ananas in Spain, in which maize or Turkish corn had been brought to maturity, provided it could be transported with sufficient expedition.*

Geronimo Benzono, a Milanese, who resided in Mexico from 1541 to 1555, caused, on his return, his History of the new world to be printed, for the first time, at Venice in 1568. In this work he highly extols the pinas; and says, he believes that no fruit on the earth can be more pleasant: sick persons, who loathed all other food, might relish it.†

After him, Andrew Thevet, a French monk, who was in Brasil from 1555 to 1556, described and delineated this plant under the name of *nanas.* The art of preserving the fruit with sugar was at that time known.‡

John de Lery, who went to Brasil in 1557 as chaplain to a Huguenot colony, in the account of his voyage first used the word *ananas*, which probably took its rise from the *nanas* of Thevet.*

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* La historia general de las Indias. Sevilla 1535. fol. lib. xvii. c. 13.

† The Latin translation is entitled *Novæ novi orbis historiæ libri tres.* Urb. Calvetonis *operâ Latini facti, et notis illustrati.*

‡ Les singularitez de la France antarctique, autrement nommée Amerique. Par André Thevet. A Anvers 1558.

In the middle of the sixteenth century Franc. Hernandes, a naturalist, undertook an expensive, and almost useless, voyage to Mexico. It cost Philip II king of Spain 60,000 ducats, and the observations he collected, for which, at the time Acosta was in America, 1200 figures were ready, were never completely printed; and in what are printed one can scarcely distinguish those of the original author from the additions of strangers. He has, however, given a somewhat better figure of the ananas, which he calls *matzatli* or *pinea Indica.*†

Christopher Acosta, in his treatise of the drugs and medicines of the East Indies,‡ printed in 1578, calls this plant the ananas. He says it was brought from Santa Cruz to the West Indies, and that it was afterwards transplanted to the East Indies and China, where it was, at that time, common. The latter part of this account is confirmed by J. Hugo de Linschotten, who was in the East Indies from 1594 to 1595.*

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* Histoire d'un voyage faict en la terre du Bresil, autrement dite Amerique. Par Jean de Lery. Geneve 1580. 8vo. p. 188. or Historia navigationis in Brasiliam, auctore Joanne Lerio. Excudebat Eustat. Vignon. 1586. 8vo. p. 162.

† Rerum medicarum novæ Hispaniæ thesaurus. Romæ 1651. fol. p. 311. The same description is to be found in Nierembergii Historia naturæ. Antverpiæ 1635. fol. p. 335.

‡ Tractado de las drogas y medicinas de las Indias Orientales, 4to.

Attempts were very early made, as Oviedo assures us, to transplant the ananas into Europe; and as in the beginning of the seventeenth century it was reckoned among the marks of royal magnificence to have orange-trees in expensive hot-houses, it was hoped that this fruit could be brought to maturity also in the artificial climate of these buildings. These attempts, however, were every where unsuccessful; no fruit was produced, or the fruit did not ripen, because, perhaps, this favourite exotic was treated with too much care. It is not certainly known who in Europe first had the pleasure of seeing ananas ripen in his garden; but it appears that several enjoyed that satisfaction at the same time in the beginning of the last century.

The German gardens in which the ananas was first brought to maturity appear to have been the following. First, that of Baron de Munchausen, at Schwobber, not far from Hameln, which on account of the botanical knowledge of its proprietor, and the abundance of plants it contains, is well known to all those who are fond of botany. In the beginning of the last century it belonged to Otto de Munchausen, who, perhaps, was the first person who erected large buildings for the express purpose of raising that fruit, and who had the noble satisfaction of making known their advantageous construction. With this view he sent a description and plan of his ananas-houses to J. Christopher Volkamer, a merchant of Nuremberg, who inserted them in his continuation of the Nuremberg Hesperides, printed there in 1714, and by these means rendered the attainment of this fruit common. This Baron de Munchausen is the same who has been celebrated by Leibnitz: "All the " travellers in the world," says that great man, " could not have given us, by their relations, " what we are indebted for to a gentleman of this " country, who cultivates with success the ananas, " three leagues from Hanover, almost on the " banks of the Weser, and who has found out th " method of multiplying them, so that we ma " perhaps, have them one day as plentiful, of o " own growth, as the Portuguese oranges, thou " there will, in all appearance, be some deficie " in the taste."* As the Baron Munchaus garden at Schwobber was in the absence of the prietor, as Volkamer says, under the care of

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* The accounts given by Acosta and Linschotten may be seen in *Bauhini Histor. plantarum*, iii. p. 95. Kircher in his *China illustrata*, Amstel. 1667, fol. p. 188, says, "That fruit which the Americans and people of the East Indies, among whom it is common, "call the ananas, and which grows also in great abundance in the "provinces of Quantung, Chiamsi, and Fokien, is supposed to have "been brought from Peru to China."

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* See Nouveaux essais sur l'entendement humain, p. Oeuvres philosophiques de M. de Leibnitz, publiés par Ra terdam 1765. 4to.

Lersner, canon of the cathedral of St. Boniface, he probably may have had some share in rendering this service to horticulture.

This fruit was produced also in the garden of Doctor Volkamer at Nuremberg, and in that of Doctor F. Kaltschmid, at Breslau, almost about the same time. The latter was so fortunate as to bring it to maturity so early as 1702, and he sent some of it then for the first time to the imperial court.[*] At Francfort on the Mayne it was first produced in 1702;[†] and at Cassel in 1715, by the skill of Wurstorfs, the head gardener.

Holland procured the first ripe ananas from the garden of De la Court, whom Miller calls Le Cour, in the neighbourhood of Leyden. As a great many plants were sold out of this garden to foreigners, and as the English had theirs first from it, many are of opinion that Europe is indebted for the first possession of this fruit to De la Court, and his gardener William de Vinck.[‡]

I shall here take occasion to mention a circumstance which belongs also to the history of gardening. Before the cultivation of the ananas was introduced, the Dutch had begun to employ tanner's bark for making forcing-beds. From them the English learned this improvement, and the first forcing-beds in England were made at Blackheath in Kent, in 1688, and employed for rearing orange-trees; but about the year 1719, much later than in Holland, ananas became more common, and forcing-beds were in much greater use.*

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[*] Breslauer Sammlung von Natur-Geschichten, 1718, Septemb. p. 1618; and 1720, Septemb. p. 302.

[†] Lersner, Chronik, ii. p. 824.

[‡] Miller's Gardener's dictionary, i. p. 132. Lueder, Wartung der Küchengewächse. Lubeck 1780. 8vo. p. 248.

This plant, the history of which I have given, received from Plumier,† who first distinguished its characterizing marks, the name of *Bromelia*, after a Swedish naturalist, whose remembrance deserves to be here revived. Olof Bromelius was born in 1639, at Oerebro, where his father carried on trade. He studied physic at Upsal, disputed there in 1667 *de pleuritide*, and in 1668 taught botany at Stockholm. In 1672 he was physician to the embassy to England, and afterwards to that to Holland, where, in 1673, he received the degree of doctor at Leyden, and wrote a dissertation *de lumbricis*. On his return to his native country, in 1674, he became a member of the college of physicians at Stockholm; but in 1691 he was city physician to Gottenburg, and provincial physician in Elfsburg and Bahus-Lan, in which situation he died in the year 1705. His botanical writings are

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* Miller, ii. p. 824. Lueder, p. 39. That putrid bark forms an excellent manure, had been before remarked by Laurembeg, *in Horticultura*, p. 52.

† Nova plantarum Americanarum genera. Parisiis 1703. 4to. p. 46.

Lupologia, and *Chloris Gothica.*[*] His son, Magnus von Bromel, is the author of *Lithographia Suecana.*[†]

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SYMPATHETIC INK.

If we give this name to any fluid which being wrote with, the letters, under certain circumstances, or after a certain operation, will become conspicuous and legible, such liquids were known in very early periods. Among the methods which Ovid teaches young women to deceive their guardians, when they write to their lovers,[‡] he mentions that of writing with new milk, and of making the writing legible by coal-dust or soot. Ausonius proposes the same means to Paulinus;[§] but

[*] Halleri Bibl. botan. i. p. 640.

[†] This account is taken from *Georg Gezelius Försök til et biographiskt Lexicon öfver lärde Svenske män,* the first part of which was published at Stockholm in 1778. 8vo.

[‡] Tuta quoque est, fallitque oculos, e lacte recenti
Litera: carbonis pulvere tange; leges.
De arte amandi, lib. iii. v. 629.

[§] Lacte incide notas; arescens charta tenebit
Semper inadspicuas; prodentur scripta favillis.
Ausonii Epist. xxiii. v. 21.

The poet afterwards teaches other methods of secret writing. Eneas, in Poliorceticis, cap. 31. and Gellius, lib. xvii. cap. 9. mention the like.

his commentators seem not to have fully understood his meaning; for *favilla* is not to be explained by *favilla non modice calida*, as Vinetus has explained it, but by *fuligo*. That word is often employed by the poets in the same sense. As a proof of it, Columella, speaking of the method, not altogether ineffectual, and even still used, of preserving plants from insects by soot, calls it *nigra favilla;* and afterwards, when mentioning the same method, free from poetical fetters, he says *fuliginem quæ supra focos tectis inhæret.** It may be easily perceived, that instead of milk any other colourless and glutinous juice might be employed, as it would equally hold fast the black powder strewed over it. Pliny, therefore, recommends the milky sap of certain plants for the like purpose.†

There are several metallic solutions perfectly colourless, or, at least, without any strong tint, which being used for writing, the letters will not appear until the paper be washed over with another colourless solution, or exposed to the vapour of it; but among all these there is none which excites more astonishment, or from which naturalists can draw more conclusions, than that which consists of a solution of lead in vegetable acid, and which by the vapour of arsenical liver of sulphur becomes black, even at a considerable distance. This ink, which may be employed by conjurers, proves the subtlety of vapour, and the porosity of bodies; as the change or colouring takes place, even when the writing is placed on the other side of a thin wall.

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* Colum. de re rust. x. 354. and xi. 3, 60. p. 773.

† Tithymalum nostri herbam lactariam vocant, alii lactucam caprinam: narrantque lacte ejus inscripto corpore, cum inaruerit, si cinis inspergatur, apparere litteras; et ita quidam adulteras alloqui maluere quam codicillis. *Plin.* lib. xxvi. cap. 8. p. 400.

This effect presented itself perhaps accidentally to some chemist; but the discovery is not of great antiquity. Wecker, who compiled his book *de secretis* from Porta, Cardan, and several old writers, and printed it for the first time in 1582, and gave a third edition in 1592, must have been unacquainted with it; else he certainly would not have omitted it in the fourteenth book, where he mentions all the methods of secret writing. Neither would it have been unnoticed by Caneparius, whose book *de atramentis* was printed at Venice, for the first time, in 1619, in quarto.

The first person who, as far as I have been able to learn, gave a receipt for preparing this ink, was Peter Borel, in *Historiarum et observationum medico-physic. centuriæ quatuor*. In this work, which was printed, for the first time, in 1653, and a second time in 1657, at Paris, and of which there were several editions afterwards, the author calls it a magnetic water, which acts at a distance.* After the occult qualities of the schoolmen were exploded, it was customary to ascribe phænomena the causes of which were unknown, and particularly those the causes of which seemed to operate without any visible agency, to magnetic effluvia; as the turmalin was at first considered to be a kind of magnet. Others concealed their ignorance under what they called sympathy, and in latter times attraction and electricity have been employed for the like purpose. Borel, who made it his business to collect new observations that were kept secret, learned the method of preparing this magnetic water from an ingenious apothecary of Mont-

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* The sixth observation of the second century is as follows: *Magnetic waters which act at a distance.* An astonishing effect, indeed, is produced by the contest of the following waters, which are thus

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made. Let quick-lime be quenched in common water, and while quenching, let some orpiment be added to it (this, however, ought to be done by placing warm ashes under it for a whole day), and let the liquor be filtered, and preserved in a glass bottle well corked. Then boil litharge of gold well pounded, for half an hour with vinegar, in a brass vessel, and filter the whole through paper, and preserve it also in a bottle closely corked. If you write any thing with this last water, with a clean pen, the writing will be invisible when dry; but if it be washed over with the first water it will become instantly black. In this, however, there is nothing astonishing; but this is wonderful, that though sheets of paper without number, and even a board be placed between the invisible writing and the second liquid, it will have the same effect, and turn the writing black, penetrating the wood and paper without leaving any traces of its action, which is certainly surprising; but a fetid smell, occasioned by the mutual action of the liquids, deters many from making the experiment. I am, however, of opinion, that I could improve this secret by a more refined chemical preparation, so as that it should perform its effect through a wall. This secret I received, in exchange for others, from J. Brosson, a learned and ingenious apothecary of Montpelier.

pelier, and in return taught him some other secrets. Otto Tachen, a German chemist,[*] afterwards thought of the same experiment, which he explains much better, without the assistance of magnetism or sympathy. The receipt for making these liquids, under the name of sympathetic ink, I find first given by Le Mort, in *Collectaneis chymicis Leydensibus*,[†] and that name has been still retained.[‡]

Another remarkable kind of sympathetic ink is that prepared from cobalt, the writing of which disappears in the cold, but appears again of a beautiful green colour, as often as one chooses, after being exposed to a moderate degree of heat.[§]

The invention of this ink is generally ascribed to a Frenchman, named Hellot. He was, indeed, the first person who, after trying experiments with it, made it publicly known, but he was not the inventor; and he himself acknowledges that a German artist of Stolberg first showed him a reddish salt, which, when exposed to heat, became blue, and which he assured him was made out of Schneeberg cobalt, with aqua regia.* This account induced Hellot to prepare salts and ink from various minerals impregnated with cobalt; but A. Gesner proved, long after, that this ink is produced by cobalt only, and not by marcasite.†

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[*] Tachenii Hippocraticæ medicinæ clavis, p. 236. This work was twice printed in 1669, viz. at Venice and Francfort.

[†] Collectanea Chymica Leydensia, id est, Mætsiana, Margraviana, Le Mortiana - - - edidit Christ. Love. Morley. Lugd. Bat. 1684. 4to. p. 97.

[‡] For an account of various kinds of secret writing see *Halle*, *Magie oder Zauberkrafte der natur.* Berlin 1783. 8vo. v. i. p. 138.

[§] The works which treat of this ink may be seen in Weigel's Chemie, p. 284.

When Hellot's experiments were made known in Germany, it was affirmed that professor H. F. Teichmeyer, at Jena, had prepared the same ink six years before, and shown it to his scholars, in the course of his lectures, under the name of sympathetic ink.‡ It appears, however, that it was invented, even before Teichmeyer, in the beginning of the last century by a German lady. This is confirmed by Pot, who says that the authoress of a book printed in 1705, which he quotes under the unintelligible title of *D. J. W. in clave*, had given a proper receipt for preparing the above-mentioned red salt, and the ink produced by it. §

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* Hist. et Mémoires de l'Académ. des Sciences a Paris. Année 1737. pp. 101 and 228.

† J. A. Gesneri Historia cadmiæ fossilis, sive cobalti. Berolini 1744. 4to.

‡ This account, together with Teichmeyer's receipt for preparing it, may be found in Commercium litterarium Norimbergense, 1737. p. 91.

§ Copiosius minera bismuthi tam ab aqua forti quam ab aqua regia dissolvitur, restante pulvere albo corroso; solutio in aqua forti roseum colorem sistit, quæ si sali in aqua soluto, secundum præscriptum *D. J. W. in clave*, affundatur, abstrahatur, ex residuo extrahitur sal roseum, quod pulverisari et cum spiritu vini extrahi potest: adeoque hæc autrix jam anno 1705 publice totum processum et fundamentum

I should be very glad if any one could give me information respecting this book, for I must confess that I am not able to conjecture what kind of a work it is. If it be true that Theophrastus Paracelsus, by means of this invention, could represent a garden in winter, it must be undoubtedly older.*

DIVING-BELL.

The first divers learned their art by early and adventurous experience, in trying to continue under water as long as possible without breathing;† and, indeed, it must be allowed that some of them carried it to very great perfection. This art, however, excites little surprise; for, like running, throwing, and other bodily dexterities, it requires only practice; but it is certain that those nations called by us uncultivated and savage excell in it the Europeans,‡ who, through refinement and

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sic dicti atramenti sympathetici, quod a calore viridescit, evulgavit. *Pot, Observationum chymicarum collectio prima.* Berolini 1739. p. 103.

* So thinks Gesner in *Selecta physico-œconomica,* or *Sammlung von allerhand zur naturgeschichte gehörigen begebenheiten.* Stutgard, vii. p. 22.

† Didicerunt quidam ad immensam altitudinem mergi, ac sine ulla respirandi vice perpeti maria. *Seneca de Ira,* ii. 12.

‡ Instances of the dexterity of the savages in diving and swimming may be seen in *Jens Kraft Sitten der wilden,* Kopenhagen 1766.

luxury, have become more delicate, and less fit for such laborious exercises.

In remote ages, divers were kept in ships to assist in raising anchors,* and goods thrown overboard in times of danger; † and, by the laws of the Rhodians, they were allowed a share of the wreck, proportioned to the depth to which they had gone in search of it.‡ In war, they were often employed to destroy the works and

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8vo. p. 39. To which may be added the account given by Maffæus of the Brasilians: "They are," says he, "wonderfully skilled in the art of diving, and can remain sometimes for hours under water, with their eyes open, in order to search for any thing at the bottom." *Hist. Indic.* lib. ii.

* ——————— pugna fuit unus in illa
Eximius Phoceus animam servare sub undis
Scrutarique fretum, si quid mansisset arenis,
Et nimis affixos unci convellere morsus,
Adductum quotiens non senserat anchora funem.
Lucanus, iii. 697.

† Per urinatores omne ferme extractum est. *Livius*, xliv. c. 10.

Corpora immergunt undis, ipsumque sub antris
Nerea et æquoreas conantur visere nymphas,
Exportantque maris prædas, et rapta profundo
Naufragia, atque imas avidi scrutantur arenas.
Manilii Astronom. v. 449.

‡ A Latin translation of these laws may be found in *Marquard de jure mercatorum*, p. 338. "If gold or silver, or any other article be "brought up from the depth of eight cubits, the person who saves it "shall receive one third. If from fifteen cubits, the person who "saves it shall, on account of the danger of the depth, receive one "half. If goods are cast up by the waves towards the shore, and "found sunk at the depth of one cubit, the person who carries them "out safe, shall receive a tenth part." See also, *Scheffer de militia navali*, Upsaliæ, 1654. 4to. p. 110.

ships of the enemy. When Alexander was besieging Tyre, divers swam off from the city, under water, to a great distance, and with long hooks tore to pieces the mole with which the besiegers were endeavouring to block up the harbour.* The pearls of the Greek and Roman ladies were fished up by divers at the great hazard of their lives; and by the like means are procured at present those which are purchased as ornaments by our fair.

I do not know whether observations have ever been collected respecting the time that divers can continue under water. Anatomists once believed that persons in whom the oval opening of the heart (*foramen ovale*) was not closed up, could live longer than others without breathing, and could, therefore, be expert divers. Haller,† however, and others, have controverted this opinion; as people who had that opening have been soon suffocated, and as animals who have it not can live a long time under water: besides, when that opening is perceptible in grown persons, it is so small as not to be sufficient for that purpose, especially as the *ductus arteriosus* is scarcely ever found open.

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* Præcipuum auxilium erat, qui procul hostium conspectu subibant aquam, occultoque lapsu ad molem usque penetrabant; falcibus palmites arborum eminentium ad se trahentes. *Curtius,* iv. c. 3. The same account is given by Arrian, *de Expedit. Alexandri M.* edit. Blancardi. Amst. 1668. 8vo. lib. ii. p. 138. We are told by Thucydides, in his seventh book, that the Syracusans did the same thing.

† Boerhaave, Prælectiones academicæ, edit. Halleri, Göttingæ 1774, 8vo. v. ii. p. 472—474. Halleri Elementa physiologiæ, edit. Lausannæ 1761. 4to. iii. p. 252. and viii. 2. p. 14.

The divers of Astracan, employed in the fishery there, can remain only seven minutes under water.* The divers in Holland seem to have been more expert. An observer, during the time they were under water, was obliged to breathe, at least, ten times.† Those who collect pearl-shells in the East Indies, can remain under water a quarter of an hour,‡ though some are of opinion that it is possible to continue longer; and Mersenne mentions a diver, named John Barrinus, who could dive under water for six hours.§ How far this may be true, I shall leave others to judge; but it is certain, that men began very early to contrive means for supplying divers with air under the water, and of thereby enabling them to remain under it much longer.

For this purpose the diving-bell, *campana urina-*

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* The divers of Astracan stepped from the warm bath into the water, in which they could not continue above seven minutes, and were brought back from the water, cold and benumbed, to the warm bath, from which they were obliged to return to the water again. This change from heat to cold they repeat five times a day, until, at length, the blood flows from their nose and ears, and they are carried back quite senseless. *Gmelins Reise durch Russland*, ii. p. 199.

† Acta philosophica societatis in Anglia, auctore Oldenburgio. Lipsiæ 1675. 4to. p. 724.

‡ Oldenburg. ut supra.

§ Scheeps-bouw beschreven door Nic. Witsen. Amsterdam 1671. fol. p. 288.

toria, was invented. Those who had no idea of this machine, might have easily been led to it by the following experiment. If a drinking-glass inverted be immersed in water, in such a manner that the surface of the water may rise equally around the edge of the glass, it will be found that the glass does not become filled with water, even when pressed down to the greatest depth; for, where there is air, no other body can enter, and by the above precaution the air cannot be expelled by the water. In like manner, if a bell of metal be constructed, under which the diver can stand on a stool suspended from it so that the edge of the bell may reach to about his knee, the upper part of his body will be secured from water, and he can, even at the bottom of the sea, breathe the air enclosed in the bell.

The invention of this bell is generally assigned to the sixteenth century, and I am of opinion that it was little known before that period. We read, however, that even in the time of Aristotle divers used a kind of kettle to enable them to continue longer under the water;* but the manner in which it was employed is not clearly described, and the translators have added many things not to be found in the original.

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* Ἔοικε δέ, ὁμοίως ἀναπνοὴν ποιοῦσι τοῖς κολυμβηταῖς λέβητα καταφέντες. Οὐ πίμπλαται γὰρ οὗτος τοῦ ὕδατος, ἀλλὰ τηρεῖ τὸν ἀέρα. μετὰ βίας γὰρ ἡ κάθεσις. ὀρθὸν γὰρ ὁτιοῦν παρεγκλιθὲν εἰσρεῖ. *Aristot.* problem. xxxii. § 5. *Thus translated by Theodore Gaza:* Plerique lebete dimisso respirandi viam urinatoribus moliuntur; haud enim aqua lebes impletur, sed aera servat ad demersum hominem usque; quippe qui erectus per vim dimittatur, ut undique æquali nutu descendat. Nam si quantumlibet inclinavit, humore protinus interrumpente impleatur ne-

The oldest information we have respecting the use of the diving-bell, in Europe, is that of John Taisnier, quoted by Schott.* The former, who was born at Hainault, in 1509, had a place at

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cesse est. *The translation of Septalius is however different.* Videtur simile quid viam respirationi natatoribus sibi parantibus, dum lebetem capiti suo supraponunt ore deorsum verso; non enim repletur id aqua, sed aerem conservat: fit enim cum violentia positio illa; rectum enim quodcunque inclinatum, influit.

* Were the ignorant vulgar told that one could descend to the bottom of the Rhine, in the midst of the water, without wetting one's clothes, or any part of one's body, and even carry a lighted candle to the bottom of the water, they would consider it as altogether ridiculous and impossible. This, however, I saw done at Toledo, in Spain, in the year 1538, before the emperor Charles V and almost ten thousand spectators. The experiment was made by two Greeks, who taking a very large kettle, suspended from ropes with the mouth downwards, fixed beams and planks in the middle of its concavity, upon which they placed themselves, together with a candle. The kettle was equipoised by means of lead fixed round its mouth, so that when let down towards the water no part of its circumference should touch the water sooner than another, else the water might easily have overcome the air included in it, and have converted it into moist vapour. If a vessel thus prepared be let down gently, and with due care, to the water, the included air with great force makes way for itself through the resisting fluid. Thus the men enclosed in it remain dry, in the midst of the water, for a little while, until, in the course of time, the included air becomes weakened by repeated aspiration, and is at length resolved into gross vapours, being consumed by the greater moisture of the water: but if the vessel be gently drawn up, the men continue dry, and the candle is found burning. *Taisneri Opuscula de celerrimo motu*, quoted by Schott in his *Technica curiosa*; lib. vi. c. 9. p. 393.

court under Charles V, whom he attended on his voyage to Africa. He relates in what manner he saw at Toledo, in the presence of the Emperor and several thousand spectators, two Greeks let themselves down under water, in a large inverted kettle, with a burning light, and rise up again without being wet. It appears that this art was then new to the Emperor and the Spaniards, and that the Greeks were caused to make the experiment in order to prove the possibility of it. After this period the use of the diving-bell seems to have become still better known. It is described more than once in the Works of Sir Francis Bacon, who explains its effects, and remarks that it was invented to facilitate labour under the water.*

In the latter part of the 17th century the diving-bell was sometimes employed in great undertakings. When the English, in the year 1588, dispersed the Spanish fleet, called the Invincible Armada, part of the ships went to the bottom, near the Isle of Mull, on the western coast of Scotland; and some of these, according to the account of the Spanish prisoners, contained great riches. This information excited, from time to time, the avarice of speculators, and gave rise to several attempts to procure part of the lost treasure. In the year 1665, a person was so fortunate as to bring up some cannon, which, however, were not sufficient to defray the expenses. Of these attempts, and the kind of diving-bell used, an account has been given by a Scotsman named Sinclair;* but Paschius,† Leupold,‡ and others falsely ascribe the invention of this machine to that learned man. He himself does not lay claim to this honour; but says only, that he conversed with the artist, and measured the machine.

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* Excellent use may be made of this vessel, which is employed sometimes in labouring under water on sunk ships, to enable the divers to continue longer under water, and to breathe, in turns, for a little while. It was constructed in this manner. A hollow vessel was made of metal, which was let down equally to the surface of the water, and thus carried with it to the bottom of the sea the whole air it contained. It stood upon three feet, like a tripod, which were in length somewhat less than the height of a man; so that the diver, when he was no longer able to contain his breath, could put his head into the vessel, and, having breathed, return again to his work. *Francisci Baconi Opera, latine translata opera S. I. Arnoldi.* Lipsiæ 1694. fol.—*Novum organum.* lib. ii. § 50. p. 408. Bacon relates the same thing in his *Phænomena universi,* p. 702.

Some years after, attempts of the like kind were renewed. William Phipps, the son of a blacksmith, born in America, in 1650, and who had been brought up as a ship carpenter at Boston, formed a project for searching and unloading a rich Spanish ship sunk on the coast of Hispaniola;

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* G. Sinclari Ars nova et magna gravitatis et levitatis. Roterodami 1669. 4to. p. 220. The description of the diving-bell has been transcribed from this work into Sturm's *Collegium curiosum*. Norimbergæ 1701. 4to.

† Paschii Inventa nov-antiqua. Lipsiæ 1700. 4to. p. 650.

‡ Theatri statici universalis pars tertia. Lipsiæ 1726. fol. p. 242.

and represented his plan in such a plausible manner, that King Charles II gave him a ship, and furnished him with every thing necessary for the undertaking. He set sail in the year 1683; but, being unsuccessful, returned again in great poverty, though with a firm conviction of the possibility of his scheme. He endeavoured, therefore, to procure another vessel from James II, who was then on the throne: but as he failed in this, he tried to find the means of executing his design by the support of private persons, and, according to the prevailing practice, opened for that purpose a subscription. At first he was laughed at; but, at length, the Duke of Albemarle, son of the celebrated general Monk, took part in it, and advanced a considerable sum to enable him to make the necessary preparations for a new voyage. Phipps soon collected the remainder; and in 1687 set sail in a ship of two hundred tons burthen, to try his fortune once more, having previously engaged to divide the profit according to the twenty shares of which the subscription consisted. At first, all his labour proved fruitless; but at last, when his patience was almost entirely exhausted, he was so lucky as to bring up, from the depth of six or seven fathoms, so much treasure that he returned to England with the value of two hundred thousand pounds sterling. Of this sum he himself got about sixteen, others say twenty thousand, and the Duke ninety thousand pounds. After he came back, some persons endeavoured to persuade the king to seize both the ship and the cargo, under a pretence that Phipps, when he solicited for his Majesty's permission, had not given accurate information respecting the business. But the King answered, with much greatness of mind, that he knew Phipps to be an honest man, and that he and his friends should share the whole among them, had he returned with double the value. His Majesty even conferred upon him the honour of knighthood, to show how much he was satisfied with his conduct. This Phipps was afterwards high sheriff of New England, and died at London, greatly respected, in 1693. This affair was attended with such good consequences to the Duke of Albemarle, that he obtained from the King the governorship of Jamaica, in order to try his fortune with other ships sunk in that neighbourhood. But whether it was that the gold had been already all taken from the one before mentioned, or that, when the vessel went to pieces, the sea had dispersed the cargo, it is certain that nothing further was found worth the labour of searching for it.*

In England, however, several companies were formed, and obtained exclusive privileges of fishing up goods on certain coasts, by the means of divers.

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* This account is taken from The History of the British Empire in America, by J. Wynne. London 1770. 2 vol. 8vo. i. p. 131, and from Campbell's Lives of the Admirals.

The most considerable of these was that which, in 1688, tried its success at the Isle of Mull, and at the head of which was the Earl of Argyle. The divers went down to the depth of sixty feet under water, remained there sometimes a whole hour, and brought up gold chains, money and other articles, which, however, when collected, were of very little importance.*—Without giving more examples of the use of the diving-bell, I shall now mention some of those who, in later times, have endeavoured to improve it. That this machine was very little known in the first half of the sixteenth century I conclude from the following circumstance. To the oldest edition of Vegetius on the art of war, there are added, by the editor, some figures, of which no explanation is given in the book. Among these is represented a method of catching fish with the hands, at the bottom of the sea. The apparatus for this purpose consists in a cap, which is fitted so closely to the head of the diver that no water can make its way between; and from the cap there arises a long leather pipe, the opening of which floats on the surface of the water. Had the person who drew these figures been acquainted with the diving-bell, he would certainly have delineated it rather than this useless apparatus.[*] Of the old figures of a diving machine that which approaches nearest to the diving-bell is in a book on fortification, by Lorini; who describes a square box bound round with iron, which is furnished with windows, and has a stool affixed to it for the diver. This more ingenious contrivance appears, however, to be older than that Italian; at least he does not pretend to be the inventor of it.[†]

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* Martin's Description of the Western Islands. The second edition. London 1716. 8vo. p. 253. Campbell's Political Survey of Britain. London 1774. 2 vol. 4to. p. 604.

In the year 1617, Francis Kessler, gave a description of his water-armour,[‡] intended also for diving, but which cannot really be used for that purpose.[§] In the year 1671, Witsen taught, in a better manner than any of his predecessors, the construction and use of the diving-bell;[‖] but he is much mistaken when he says that it was invented at Amsterdam. In 1679 appeared, for the first time, Borelli's well-known work *de motu*

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[*] These figures are to be found in the following editions: Fl. Vegetii Renati de re militari. Lutetiæ apud C. Wechelum 1532. fol. p. 180. Flavii Feget. Renati vier bucher von der Rytterschafft. Gedrukt, yn der loblichen stat Erfurt, durch Hanssen Knappen, 1511. fol. mit mönchsschrift.—These figures are inserted also in Leupold's *Theatrum pontificale*, p. 11. tab. ii. fig. 6.

[†] Le fortificationi di Bounaiuto Lorini, nuovamente ristampate. In Venetia 1609. fol. p. 232. Lorini funf bücher von Bestung bauwen, übergesetst von David Wormbser. Frankfort 1607. fol. p. 201.

[‡] Fran. Kessleri Secreta. Oppenheim 1617. 8vo. nebst kupfertafeln.

[§] Bartholini Acta Hafn. 1676. p. i. obs. 17.

[‖] Scheeps-bouw, ut supra.

animalium,[*] in which he not only described the diving-bell, but also proposed another, the impracticability of which was shown by James Bernoulli.[†] When Sturm published his *Collegium curiosum*, in 1678, he proposed some hints for the improvement of this machine, on which remarks were made in the *Journal des sçavans*.[‡] None, however, have carried their researches further for this purpose than Dr. Halley, and Triewald a Swede.

The bell which Edmund Halley, secretary to the royal society, caused to be made, was three feet broad at the top, five feet at the bottom, and eight feet in height; forming a cavity of sixty-three cubic feet. It was covered with lead; and was so heavy that it sunk to the bottom, even when entirely empty. Around the lower edge, weights were disposed in such a manner that it should always sink in a perpendicular direction, and never remain in an oblique position. In the top was fixed a piece of strong glass to admit the light from above, and likewise a valve to give a passage to the air corrupted by the breath. Around the whole circumference of the bottom was placed a seat, on which the divers sat; and a stool, fixed to ropes, hung below, on which they could stand in order to work. The whole machine was suspended from a cross beam fastened to the mast of a ship, so that it could be easily lowered down into the water and again drawn up. That the bell might be supplied with fresh air, under the water, large vessels filled with air, and which had an opening below through which the water compressed the included air, were let down by ropes. In the top of these vessels were leather pipes, besmeared with oil, through which the diver introduced air from the vessels into the bell; and as soon as a vessel was emptied, it was drawn up, on a signal made by the diver, and another let down. The foul air in the bell, being the warmest and lightest, rose to the top of the machine, where it was suffered to escape through the valve before mentioned. By these means the bell could be continually supplied with fresh air, in such abundance that Halley, and four other persons, remained under water, at the depth of ten fathoms, an hour and a half, without suffering the least injury, and could, with equal security, have continued longer, or even as long as they might have wished. This precaution, however, is necessary, that the bell be let down at first very slowly, that the divers may be gradually accustomed to inspire the compressed air; and at every twelve fathoms the bell must be held fast, in order to expel the water which has rushed in, by letting fresh air into it. By such apparatus, Halley was enabled to make the bottom of the sea, within the circumference of the bell, so dry that the sand or mud did not rise above his shoe. Through the window, in the top, so much light was admitted, that when the sea was still, and the waves did not roll, he could see perfectly well to read and write under the water. When the empty air-vessels were drawn up, he sent up with them his orders, written with an iron spike on a plate of lead, and could thus let those above know when he wished to be removed with the bell to another place. In bad weather, and when the sea was rough, it was as dark under the bell as at night; he then kindled a light; but a burning candle consumed as much air as a man. The only inconvenience of which Halley complained was, that, in going down, he felt a pain in his ears, as if a sharp quill had been thrust into them. This pain returned every time the bell was let down to a greater depth, but soon went off again. A diver thought to prevent this pain by putting chewed paper into both his ears; but the bits of paper were forced in so far by the air, that a surgeon found great difficulty to extract them. That he might be able to send a diver to the distance of several fathoms from the bell on the bottom of the sea, Halley invented a leaden cap, which covered the diver's head. This cap had glass before it, contained as much air as was sufficient for two minutes, and had affixed to it a thick pliable pipe, with the other end fastened to the bell, and which, at the cap, was furnished with a valve to convey fresh air to the diver from the bell. This pipe, which the diver was obliged to wind round his arm, served him also as a guide to find his way back to the bell.*

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[*] I have before me, from the library of professor Hollmann, the edition printed at the Hague, 1743, in quarto, in which the description alluded to may be found, i. p. 222. It will perhaps be agreeable to many to know that this whole work is printed in *Mangeti Bibliotheca anatomica*. Genev. 1669. 2 vol. fol.

[†] Acta eruditorum, 1683, Decemb. p. 553. *Jac. Bernoulli* Opera.

[‡] Journal des sçavans, 1678, Jan.

The last improvement of the diving-bell is by the well-known Triewald, a Swede. His bell, which was much smaller and more commodious, was made of copper, tinned in the inside. On the top there were panes of glass, which, for the greater security, were fixed in a frame of the same metal. The stool below was placed in such a manner, that the head only of the diver, when he stood upon it, rose above the surface of the water in the bell. This situation is much better than when the whole body is raised above the water in the bell, because near the surface of the water the air is much cooler and fitter to breathe in than at the top of the machine. That the diver also might remain conveniently in the upper part of the bell, Triewald arranged his apparatus so that when the diver had breathed as long as possible in the upper air, he found at the side of the bell a spiral pipe, through which he could draw in the lower cool air which was over the surface of the water. To the upper end of this copper pipe was affixed a pliable leather one, with an ivory mouth-piece, which the diver put into his mouth, and could thus inspire fresh air, in whatever position his body might be.*

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* Philosophical Transact. 1717 and 1721. The art of living under water, by Halley.

An Englishman invented also a complete apparatus of strong thick leather, which contained half a hogshead of air. It was so prepared, that no air could escape through it; was constructed in such a manner that it exactly fitted the arms and legs, and had glass placed in the forepart of it. When he put on this apparatus, he could not only walk on the ground at the bottom of the sea, but also enter the cabin of a sunk ship, and convey goods out of it at pleasure. The inventor carried on this business for more than forty years, and acquired by it considerable property.†

COLOURED GLASS. ARTIFICIAL RUBIES.

It is probable that there was no great interval between the discovery of the art of making glass, and that of giving it different colours. When the substance of which it is formed contains, by accident, any metallic particles, the glass assumes some tint; and this happens oftener than is wished; nay, a considerable degree of foresight is necessary to produce glass perfectly colourless; and I am of opinion that this skill has not been attained till a late period in the progress of the art. Even in Pliny's time the highest value was set upon glass entirely free from colour, and transparent, or, as it was called, crystal.* From the different colours which glass acquired of itself, it was easy to conceive the idea of giving it the tinge of some precious stone: and this art, in ancient times, was carried to a very great extent. Proofs of this may be found in Pliny,† who, besides others, mentions artificial hyacinths, sapphires, and that black glass which approached very near to the obsidian stone, and which in more than one place he calls *gemmæ vitreæ*.‡ Trebellius Pollio relates in how whimsical a manner Gallienus punished a cheat who had sold to his wife a piece of glass for a jewel:* and Tertullian ridicules the folly of paying as dear for coloured glass as for real pearls. The glass-houses at Alexandria were celebrated among the ancients for the skill and ingenuity of the workmen employed in them. From these the Romans, who did not acquire a knowledge of that art till a late period, procured for a long time all their glass ware. The learned author of *Recherches sur les Egyptiens et les Chinois*, in the end of his first volume, relates more of these glass-houses than I know where to find in the works of the ancients; but it is certain that coloured glass was made even in those early ages. The emperor Adrian received as a present from an Egyptian priest, several glass cups which sparkled with colours of every kind, and which, as costly wares, he ordered to be used only on grand festivals.† Strabo tells us, that a glass-maker in Alexandria informed him that an earth was found in Egypt, without which the valuable coloured glass could not be made.*

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* Philosophical Transact. 1736.—Martin Triewald's Konst at lefwa under watnet. Stockholm 1741. 4to.

† Martin's Philosophia Britannica.

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* Maximus tamen honos in candido translucentibus, quamproxima crystalli similitudine. *Plin.* lib. xxxvi. c. 26.

† Ibid.

‡ Lib. xxxv. c. 26. and lib. xxxvii. c. 9. The *lapis obsidianus*, which Obsidius first found in Ethiopia, and made known, is undoubtedly the same as that vulcanic glass which is sometimes called Icelandic agate, *pumex vitreus*, and by the Spaniards, who brought it from America and California, named *galinace*. Thick pieces of it are opake, but thin pieces are transparent. The colour of it is generally very black, but in thin pieces it is only blackish and almost like the dark topaz. Sometimes it is also blue, which is often the case in the Venetian. On the sea-coast near Algiers, some pieces of it are found green. The Carpathian mountains produce all kinds of it. See my *Physikalisch-ökon. biblioth.* iv. p. 29. v. p. 214. and vi. pp. 182, 371.

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* Idem, cum quidam gemmas vitreas pro veris vendidisset ejus uxori, atque illa, re prodita, vindicari vellet, surripi quasi ad leonem venditorem jussit, deinde e cavea caponem emitti: mirantibusque cunctis rem tam ridiculam, per curionem dici jussit, *Imposturam fecit et passus est*; deinde negotiatorem dimisit. *Historiæ Augustæ scriptores, in vita Gallieni*, cap. 12.

† Adrian in his letter writes as follows: Calices tibi allassontes versicolores transmisi, quos mihi sacerdos templi obtulit, tibi et sorori meæ specialiter dedicatos, quos tu velim festis diebus conviviis adhibeas. *Vopiscus in vita Saturnini*, c. 8.

Seneca, in his ninetieth epistle, in which he judges too philosophically, that is, with too little knowledge of the world, in regard to the value of labour, mentions one Democritus who had discovered the art of making artificial emeralds;† but in my opinion this discovery consisted in giving a green colour by cementation to the natural rock crystal: and this art I imagine was treated of in that book, the name of which Pliny, through an over anxious care lest the deception should become common, does not mention.‡ For colouring crystal and glass, so as to resemble stones, Porta,* Neri,† and others have, in modern times, given directions which are, however, not much used, because the crystal is thereby liable to acquire so many flaws that it cannot be easily cut afterwards, though, as Neri assures us, these by attention may sometimes be avoided.

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* Ἐιναι τινα και κατ᾽ Αἴγυπτον ὑαλῖτιν γῆν, ἧς χωρὶς οὐχ οἷόν τε τας πολυχρόνους καὶ πολυτελεῖς κατασκευὰς ἀποτελεσθῆναι. Strabo. Amstelod. apud Wolters 1707. fol. lib. xvi. p. 1099.——Some consider the glass earth here mentioned as a mineral alkali, that was really found in Egypt, and which served to make glass; but, as the author speaks expressly of coloured glass, I do not think that the above salt, without which no glass was then made, is what is meant; but rather a metallic earth, such perhaps as ochre or manganese.

† Excidit porro vobis eundem Democritum invenisse quemadmodum ebur poliretur, quemadmodum decoctus calculus in smaragdum converteretur, qua hodieque coctum inventi lapides coctiles colorantur. Edit. Lipsii, p. 579.

‡ Quin immo etiam extant commentarii auctorum, quos non equidem demonstrarim, quibus modis ex crystallo tinguntur smaragdi, aliæque translucentes, sardonix e sarda, etiam ceteræ ex aliis. Neque est ulla fraus vitæ lucrosior. Lib. xxxvii. c. 12. A passage in Diodorus Siculus, lib. ii. c. 52. alludes, in my opinion, to this method of colouring by cementation.

It is worthy of remark, that in some collections of antiquities at Rome, there are pieces of coloured glass which were once used as jewels. In the *Museum Victorium*, for example, there are shown a chrysolite and an emerald, both of which are so well executed, that they are not only perfectly transparent and coloured throughout, but neither externally nor internally have the smallest blemish; which certainly could not be guarded against without great care and skill.‡

What materials the ancients used for colouring glass, has not been told to us by any of their writers. It is, however, certain that metallic calces only can be employed for that purpose, because these pigments withstand the heat of the glass furnaces; and it is highly probable that ferruginous earth, if not the sole, was at least the principal substance by which not only all shades of red, violet, and yellow, but even a blue colour, could be communicated, as professor Gmelin has shown.* Respecting the red, of which only I mean here to speak, there is the less doubt, as, at present, sometimes an artificial, and sometimes a natural, iron ochre is often employed for that purpose. For common works this is sufficient; but when pure clear glass, coloured strongly throughout with a beautiful lively red, free from flaws, and in somewhat large pieces, is required, iron is not fit, because its colour, by the continued heat necessary for making glass, either disappears or becomes dirty and almost blackish.†

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* Magia naturalis. Franc. 1591. 8vo. p. 275.

† Kunkel's Ars vitraria. Nuremberg, 1743. 4to. pp. 98, 101.

‡ Dissertatio glyptographica, sive Gemmæ duæ vetustissimæ - - - quæ extant Romæ in Museo Victorio. Romæ 1739. 4to. pp. 105, 106.

In the last century, some artists in Germany first fell upon the method of employing gold, instead of iron, and of thereby making artificial rubies, which when they were well set could deceive the eye of a connoisseur, unless he tried them with a diamond or a file. The usual method was to dissolve the gold in aqua regia, and to precipitate it by a solution of tin, when it assumed the form of a purple-coloured powder. This substance, which must be mixed with the best frit, is called the precipitate, or gold-calx, of Cassius, gold-purple, or mineral-purple.[*]

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* De cæruleo materiarum vitro æmularum in antiquis monumentis obviarum colore, in Commentationibus Societ. Scient. Gottingensis, ii. p. 41. A Translation of this dissertation may be seen in the fifth part of Crell's Chemical Journal.

† Montamy von den farben zum porzellan- und email-malen. Leipsic 1767. 8vo. p. 82. Fontanieu, p. 16.

This Cassius, from whom it takes its name, was called Andrew, and because both the father and son had the same christian name, they have been often confounded with each other. The father was secretary to the duke of Schleswig, and is not known as a man of letters: but the son is celebrated as the inventor or preparer of the gold-purple, and of a bezoar-essence. He took the degree of doctor at Leyden, in 1632, practised physic at Hamburgh, and was appointed physician in ordinary to the bishop of Lubec. As far as I know, he never published any thing respecting his art; but this service was rendered to the public by his son, who was born at Hamburgh, and resided as a physician at Lubec. He was the author of a well-known treatise, now exceedingly scarce, entitled: *Thoughts concerning that last and most perfect work of nature, and chief of metals, gold, its wonderful properties, generation, affections, effects, and fitness for the operations of art; illustrated by experiments.*[†]

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[*] Some excellent remarks respecting the preparation of this gold-purple, which is rather difficult, may be found in *L'art de faire les cristaux colorés imitans les pierres précieuses, par M. Fontanieu*, Paris 1778, 8vo. p. 11. *Lewis, Zusammenhang der künste. Zürich* 1764, 8vo. i. p 276. *Baume, Experimental Chemie*, iii. pp. 87, 109, 309. The latter gives a different method of preparing the gold, which he calls reducing it to a calx by quick-silver.

[†] The original title runs thus: De extremo illo et perfectissimo naturæ opificio ac principe terrenorum sidere, auro, et admiranda ejus

From this work it will be easily understood why the author does not give himself out as the inventor of the gold-purple,* which he is commonly supposed to be, at which Lewis is much astonished. It is seen also by it that Leibnitz calls him improperly a physician at Hamburgh, having probably confounded the father and son together.† Upon the whole, it is not proved that any of the Cassius's was the inventor of the above precipitate, else it would certainly not have been omitted‡ in this treatise; and mention of gold-purple is to be found in the works of several old chemists. §

Something of this kind has, doubtless, been meant by the old chemists, when they talk of red lions, the purple soul of gold, and the golden mantle; but what they wished to conceal under these metaphors, I am not able to conjecture. In

natura, generatione, affectionibus, effectis, atque ad operationes artis habitudine, cogitata; experimentis illustrata. Hamburgi 1685. 8vo.

* John Molleri Cimbria literata. Havniæ 1774. fol. i. p. 88.

† Miscellanea Berolinensia, i. p. 94.

‡ We find nothing more than the following words: *Est tamen modus adhuc alius, quique hactenus secretior fuit, quo, per singularem auri mediante liquore Jovis præcipitationem, sulphur ejus fixum eleganter extravertitur.* The author shows only, in a brief manner, in how many ways this precipitate can be used: but he makes no mention of the employing it in colouring glass.

§ I cannot, however, affirm that the *vasa murrhina* of the ancients were a kind of porcelain coloured with this calx of gold. This is only a mere conjecture, to be seen in *Oeuvres de M. Bosc d'Antic.* Paris 1780. 2 vol. 12mo. i. p. 230.

the year 1606, when Libavius published his Alchemy, the art of making ruby-glass must have been unknown. He indeed quotes an old receipt for making rubies; and conjectures, that because the real stones of the same name are found in the neighbourhood of gold mines, they may have acquired their colour from that metal; and that, by means of art, glass might be coloured by a solution of gold.* The later chemists, however, and particularly Achard, found no traces of gold, but of iron, in that precious stone.† The idea which Libavius conceived from a false deduction, has nevertheless been confirmed by experience.

Neri, who lived almost at the same time as Libavius,‡ was better acquainted with the gold-purple, though his receipt is very defective. According to his directions, the gold solution must be evaporated, and the residue suffered to remain over the fire until it becomes of a purple colour;

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* Rubini frequentes sunt circa montem piniferum, ubi et auri venæ. Consentaneum est, principia auri ibi degenerare in hanc gemmam. Ex tinctura auri rubea in liquorem seu oleum soluta, et crystalli liquore potissimum, non incommode fieri posse judicaverim. *Alchymia Andreæ Libavii.* Franc. 1606. fol. ii. tract. i. c. 34. p. 88.

† See Gotting. Gel. Anzeigen, 1778. p. 177.

‡ It is well known that Neri's works are translated into Kunkel's *Ars vitraria*; the edition of which published at Nuremberg in 1743 I have in my possession. The time Neri lived is not mentioned in the Dictionary of Learned Men; but it appears, from the above edition of Kunkel, that he was at Florence in 1601, and at Antwerp in 1609. The oldest Italian edition of his works I have ever seen is *L'arte vetraria—del R. P. Antonio Neri, Fiorentino.* In Venetia, 1663. The first edition, however, must be older.

One may readily believe that this colour will be produced; but glass will scarcely be coloured equally through by this powder, and perhaps some of the gold particles will show themselves in it. Kunkel affirms, and not without reason, that something more is necessary to make rubies by means of gold; but he has not thought proper to tell us what it is.[*]

Glauber, who wrote his *Philosophical Furnace*[†] about the middle of the 17th century, appears to have made several experiments with the gold-purple. He dissolved the metal in aqua-regia; precipitated it by liquor of flint, and melted into glass the precipitate, which contained in it abundance of vitreous earth.[‡]

None, however, in the 17th century, understood better the use and preparation of gold-purple than John Kunkel, who, after being ennobled by Charles XI, king of Sweden, assumed the name of Löwenstiern. He himself tells us, that he made artificial rubies in great abundance, and sold them, by weight, at a high price. He says, he made for the elector of Cologne a cup of ruby glass, weighing not less than twenty-four pounds, which was a full inch in thickness, and of an equally beautiful colour throughout. He employed himself most on this art after he engaged in the service of Frederic William elector of Brandenburg, in the year 1679. At that time he was inspector of the glass-houses at Potsdam; and, in order that the art of making ruby-glass might be brought to perfection, the elector expended 1600 ducats. A cup with a cover, of this manufacture, is still preserved at Berlin.* Kunkel, however, has no where given a full account of this art. He has only left in his works a few scattered remarks, which Lewis has collected.†

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[*] Neri, b. vii. c. 129. pp. 157 and 174.

[†] I am acquainted with the Amsterdam Latin edition of 1651, in four small volumes, octavo, where the passage to which I allude is to be found in vol. iv. p. 78. In the common German edition, *Glauberi Opera Chymica*, Franc. 1658 and 1659, 2 vol. quarto, it is in vol. ii. pp. 125, 243. Lewis says, that *Furnus Philosophicus* was printed as early as 1648.

[‡] Glauber first made known liquor of flint, and recommended it for several uses, as Ettmuller says in *Collegium pharmaceut.* See *M. Ettmulleri Opera*, Genevæ 1736, 4 vol. fol. ii. p. 170.

In the year 1684, earlier than Cassius, John Christian Orschal wrote his well-known work *Sol sine veste*,‡ in which he treats, more intelligibly than any one before him, of the manner of making ruby-glass. He, however, confesses that Cassius first taught him to precipitate gold by means of tin; that Cassius traded in glass coloured with this precipitate, and that a good deal of coloured glass was then made at Freysingen, but that the art was kept very secret. As Orschal deserves that his fate should be better known, I shall here mention the following few particulars respecting him. About the year 1682 he was at Dresden, in the service of John Henry Rudolf, from whom he learnt many chemical processes, and particularly amalgamation, by which he gained money afterwards in Bohemia. After this he was employed at the mines in Hesse; but he brought great trouble upon himself by polygamy and other irregularities, and died in a monastery in Poland.*

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* Nicolai Beschreibung der Residenzstädte Berlin und Potsdam, ii. p. 993.

† Lewis, Zusammenhang der Künste. Zürich 1764. 2 vol. octavo, i. p. 279.

‡ The first edition was printed at Augsburg, in duodecimo, and the same year at Amsterdam. It has been often printed since, as in 1739, in three vol. quarto, without name or place.

Christopher Grummet, who was Kunkel's assistant, wrote, in opposition to Orschal, his known treatise *Sol non sine veste*, which was printed at Rothenburg, in 1685, in duodecimo.† In like manner, an anonymous author printed against Orschal, at Cologne, in 1684, another work, in duodecimo, entitled *Apelles post tabulam observans maculas in Sole sine veste.* The dispute, however, was not so much concerning the use of gold-purple, as the cause of the red colour, and the vitrification of gold.

It is worthy of remark, that Kunkel affirms he could give to glass a perfect ruby-red colour without gold; which Orschal and most chemists have however doubted. It is nevertheless said, that Krüger, who was inspector of the glass-houses at Potsdam, under Frederic William king of Prussia, discovered earlier the art of making ruby-glass without gold, and that a cup and cover of cut glass made in this manner is still preserved at Berlin.*

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* So we are told in *J. H. Rudolf's Dresdensis Elementa Amalgamationis,* first printed at Arnstadt in 1712. 4to.

† A French translation of Orschal and Grummet is added to *l'Art de la verrérie de Neri, Merret et Kunkel.* Paris 1752, 4to. The editor is the Baron de Holbach, who, however, has not put his name to the work.

Painting on glass and in enamel, and the preparation of coloured materials for mosaic work, may, in certain respects, be considered as branches of the art of colouring glass; and in all these a beautiful red is the most difficult, the dearest, and the scarcest. When the old master-pieces of painting on glass are examined, it is found either that the panes have on one side a transparent red varnish burnt into them, or that the pieces which are stained through and through, are thinner than those coloured in the other manner.† It is, therefore, extremely probable that the old artists, as they did not know how to give to thick pieces a beautiful transparent red colour, employed only iron, or manganese, which pigment, as already observed, easily becomes in a strong heat blackish and muddy.* Enamel-painters, however, were for a long time obliged to be contented with it. A red colour in mosaic work is attended with less difficulty, because no transparency, nay rather opacity, is required. At Rome those pieces are valued most which have the beautiful shining red colour of the finest sealing-wax. We are told by Ferber that such pieces were, at one time, made only by a man named Mathioli, and out of a kind of copper dross; at present there are several artists in that city who prepare these materials, but they are not able to give them a perfect high colour.†

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* Nicolai, ut supra.

† See Peter le Vieil's *Kunst auf glas zu malen*, Nuremberg 1779, 4to. ii. p. 25. This singular performance must, in regard to history, particularly that of the ancients, be read with precaution. Seldom has the author perused the works which he quotes; sometimes one cannot find in them what he assures us he found, and very often he misrepresents their words.

SEALING-WAX.

WRITERS on diplomatics mention, besides metals, five other substances on which impressions were made, or with which letters and public acts were sealed, viz. *terra sigillaris*, cement, paste, common wax, and sealing-wax.‡ The *terra sigillaris* was used by the Egyptians, and appears to have been the first substance employed for sealing.* The Egyptian priests bound to the horns of the cattle fit for sacrifice a piece of paper; stuck upon it some sealing-earth, on which they made an impression with their seal; and such cattle only could be offered up as victims.†

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* In what the art of Abraham Helmback, a Nuremberg artist, consisted, I do not know. Doppelmeyer, in his Account of the mathematicians and artists of Nuremberg, printed in 1730, says that he fortunately revived, in 1717, according to experiments made in a glass-house, the old red glass; the proper method of preparing which had been long lost.

† Ferber's Briefe aus Welschland. Prague 1773. 8vo. p. 114.

‡ Gattereri Elementa artis diplomaticæ. Gœttingæ 1765. 4to. p. 285.

Lucian speaks of a fortune-teller who ordered those who came to consult him to write down on a bit of paper the questions they wished to ask, to fold it up, and to seal it with clay, or any other substance of the like kind.‡ Such earth seems to have been employed in sealing by the Byzantine emperors; for we are told, that at the second council of Nice, a certain person defended the worship of images by saying, no one believed that those who received written orders from the emperor, and venerated the seal, worshipped on that account the sealing-earth, the paper, or the lead.§

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* It is singular that Pliny denies that the Egyptians used seals: Non signat Oriens aut Ægyptus etiam nunc, litteris contenta solis. Lib. xxxiii. c. 1. Herodotus however, and others, prove the contrary; and Moses speaks of the seal-rings of the Egyptians. See *Goguet*.

† Σημαίνεται βύϐλω περι τα κέρεα ἑλίσσων. Και ἔπειτα γῆν σημαντρίδα ἐπιπλασας, ἐπιϐαλλει τον δακτύλιον. Herodot. lib. ii. c. 38. edit. Francofurti 1608. fol.

‡ Ες βιϐλίον ἐγγράψαντα, καταῤῥάψαι τέ, και κατασημήνασθαι κηρῷ ἢ πηλῷ ἢ ἄλλω τοιούτω. Lucian. in Pseudomant.

§ 'Ο κέλευσιν βασιλέως δεξάμενος, και ἀσπασάμενος τὴν σφραγίδα, οὐ τον πηλον ἐτίμησεν, ἢ τὴν χάρτην, ἢ τὸν μολυϐδον, ἀλλα—Act. iv. ap. Bin. tom. iii.

Cicero relates, that Verres having seen in the hands of one of his servants, a letter written to him from Agrigentum, and having observed on it an impression in sealing-earth (*cretula*), he was so pleased with it that he caused the seal-ring with which it was made to be taken from the possessor.* The same orator, in his defence of Flaccus, pro-

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Concil. part. i. p. 356. Whether the γη σημαντρις, however, of Herodotus and the πηλος of Lucian and of the Byzantine be the same kind of earth, can be determined with as little certainty as whether the *creta*, called by some Roman authors a sealing-earth, be different from both.

* Cum Valentino ejus interpreti epistola Agrigento allata esset, casu signum iste animadvertit in cretula; placuit ei; exquisivit unde esset epistola; respondit, Agrigento: iste litteras ad quos solebat, misit, ut is annulus ad se primo quoque tempore afferretur. Ita litteris istius patrifamilias, L. Titio cuidam, civi Romano, annulus de digito detractus est. *Orat. in Verrem*, iv. c. 9.

In the above passage some instead of *cretula* read *cerula*. I shall here take occasion to remark, also, that in the Acts of the Council of Nice before mentioned, instead of πηλον some read κηρον: but I do not see a sufficient reason for this alteration, as in the before-quoted passage of Lucian it is expressly said, that people sealed κηρῷ ἢ πηλῷ. Reiske himself, who proposes that amendment, says, that πηλὸν may be retained. Stephen, however, does not give that meaning to this word in his Lexicon. Pollux and Hesychius tell us, that the Athenians called sealing-earth also ῥύπον. The former, *Onomast.* x. 14. 59, says, Non ignorandum, quod ceram signando idoneam, τὸν ἐπιτήδειον εις τὸ κατασημαίνεσθαι κηρὸν, veteres ῥύπον nominaverunt et ῥύπους, ut in Lysistrate Aristophanes: et nihil ita bene conclusum esse, quin obsignationes, ῥύπους, avellatis: and the latter, Ῥύπον Αττικοὶ τον εις τας σφραγίδας κηρὸν λεγουσιν: Attici ῥύπον vocant ceram cujus ad sigilla usu est. Stephen says, in his Lexicon, vol. iii. p. 727, that *rhypos*, i this sense, occurs in Cicero's Letters to Atticus: In v. l. annotatur legi et apud Cic. in ep. ad Att. *rhypos* pro ceris sive formis unde s gilla fiebant, fortasse a situ vetustatis. But though Cœlius Rhod duced an attestation sent from Asia, and proved its authenticity by its being sealed with Asiatic sealing-earth; with which, said he to the auditors, as you daily see, all public and private letters in Asia are sealed: and he showed, on the other hand, that the testimony brought by the accuser was false, because it was sealed with wax, and for that reason could not have come from Asia.* The scholiast Servius relates, that a sibyl received a promise from Apollo, that she should live as long as she did not see the earth of the island Erythræa where she resided; that she therefore quitted the place, and retired to Cumæ, where she became old and decrepid; but that having received a letter sealed with Erythræan earth (*creta*), when she saw the seal she instantly expired.†

No one, however, will suppose that this earth

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gius mentions the same thing, *Lection. Antiq.* xxi. 23, in the following words, Pro caeris quoque in epistolis ad Atticum legimus *rhypos*, de vetustatis ratione nomenclatura accersita; that expression is not to be found, at present, in Cicero.

* Hæc quæ a nobis prolata laudatio, obsignata erat creta illa Asiatica, quæ fere est omnibus nota nobis, qua utuntur omnes non modo in publicis, sed etiam in privatis litteris, quas quotidie videmus mitti a publicanis, sæpe unicuique nostrum. Neque enim testis ipse, signo inspecto, falsum nos proferre dixit; sed levitatem totius Asiæ protulit, de qua nos et libenter et facile concedimus. Nostra igitur laudatio - - - consignata creta est; in illo autem testimonio, quod accusatori dicitur datum, ceram esse videmus.—*Orat. pro Flacco*, c. 16.

† Sibyllam Apollo pio more dilexit, et ei obtulit poscendi quod vellet arbitrium. Illa hausit arenam manibus, et tam longam vitam

was the same as that to which we at present give the name of *creta*, chalk; for if it was a natural earth it must have been of that kind called potters-clay, as that clay is capable of receiving an impression and of retaining it after it is hardened by drying. That the Romans, under the indefinite name of *creta*, often understood a kind of potters-earth, can be proved by many passages of their writers. Columella speaks of a kind of chalk of which wine-jars and dishes were made.[*] Virgil calls it tough;[†] and the ancient writers on agriculture give the same name to marl which was employed to manure land.[‡] Notwithstanding all these authorities, I do not clearly comprehend how letters could be sealed with potters-clay, as

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poposcit. Cui Apollo respondit, id fieri posse, si Erythræam, in qua habitabat, insulam relinqueret, et eam nunquam videret. Profecta igitur, Cumas tenuit; et illic defecta corporis viribus vitam in sola voce retinuit. Quod cum cives ejus cognovissent, sive invidia sive commiseratione commoti, ei epistolam miserunt creta antiquo more signatam; qua visa, quia erat de ejus insula, in mortem soluta est. *Serv. ad lib.* vi. *Æneid.* p. 1037.

[*] Ex ea creta qua fiunt amphoræ, lata vasa in modum patinarum fieri jubebat. Lib. xii. c. 43.

[†] Et creta solidanda tenaci. *Georg.* i. v. 179.

[‡] Creta fossica, qua stercorantur agri. *Varro*, i. 7. 8.—It appears also, that the πηλος of the Greeks signified a kind of potters-earth. Those who do not choose to rely on our dictionaries, need only to read the ancient Greek writers on husbandry, who speak of ἀῤῥαγ[illegible] πηλῷ ἀργιλλώδει. See *Geopon.* x. c. 75. 12. and ix. c. 10. 4. That many kinds of sealing-earth, without being burnt, will long retain an impression, is proved by the sealed-earths preserved in our apothecaries' shops, and collections of natural history.

it does not adhere with sufficient force either to linen, of which, in ancient times, the covers of letters were made, or to parchment; as it must be laid on very thick to have a distinct impression; as it is long in drying, and is again easily softened by moisture; and, at any rate, if conveyed by post at present, it would be crumbled to dust in going only from Hamburgh to Altona. I can readily believe that the Roman messengers employed more skill and attention to preserve the letters committed to their care than are employed by our postmen; but the distance from Asia to Rome is much greater than that from Hamburgh to Altona.

But may there not be as little foundation for the ancient expression *creta Asiatica*, Asiatic earth, as for the modern expression, *cera Hispanica*, Spanish wax? May not the former have signified a kind of coarse artificial cement? These questions might be answered by those who have had an opportunity of examining, or only seeing, the *sigilla cretacea* in collections of antiquities. We are assured that such are still preserved; at least we find in Ficoroni * the representation of six impressions which, as he tells us, consisted of that earth. In that author, however, I find nothing to clear up my doubts; he says only that some of these seals were white;

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* I piombi antichi, opera di Francesco de Ficoroni. In Roma 1740. 4to. p. 16. Sigilli de creta, tanto più curiosi, quanto più rari.

others of a gray colour, like ashes; others red, and others brown. They seem all to have been enclosed in leaden cases. Could it be proved that each letter was wrapped round with a thread, and that the thread, as in the seals affixed to diplomas, was drawn through the covering of the seal, the difficulty which I think occurs in the use of these earths, as mentioned by the ancients, would entirely disappear.* It seems to me remarkable that neither Theophrastus nor Pliny says any thing of the Asiatic *creta,* or speaks at all of sealing-earth; though they have carefully enumerated all those kinds of earth which are worth notice on account of any use.

In Europe, as far as I know, wax has been every where used for sealing since the earliest ages. Writers on diplomatics, however, are not agreed whether yellow or white wax was first employed; but it appears that the former, on account of its low price, must have been first and principally used, at least by private persons. It is probable, also, that the seals of diplomas were more durable when they consisted of yellow wax; for it is certain that white wax, which loses a great part of its inflammable substance, is more brittle, and much less durable. Many seals also may at present be considered white which were at first yellow; for not only does wax highly bleached resume, in time, a dirty yellow colour, but yellow wax also, in the course of years, loses so much of its colour as to become almost like white wax. This perhaps may account for the oldest seals appearing to be of white, and the more modern of yellow wax. These, however, are conjectures which I submit, with deference, to the determination of those versed in diplomatics.

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* Heineccius and others think that the *amphoræ vitreæ diligenter gypsatæ,* in Petronius, were sealed; but it is much more probable that they were only daubed over or closed with gypsum, for the same reason that we pitch our casks.

In the course of time, sealing-wax was coloured red; and a good deal later, at least in Germany, but not before the fourteenth century, it was coloured green, and sometimes black. I find it remarked that blue wax never appears on diplomas; and I may, indeed, say it is impossible it should appear; for the art of giving a blue colour to wax has never yet been discovered; and in old books, such as that of Wecker, we find no receipt for that purpose. Later authors have pretended to give directions how to communicate that colour to wax: but they are altogether false; for vegetable dyes, when united with wax, become greenish, so that the wax almost resembles the hip-stone; and earthy colours do not combine with it, but, in melting, fall again to the bottom. A seal of blue wax, not coloured blue merely on the outer surface, would be as great a rarity in the arts as in diplomatics, and would afford matter of speculation for our chemists; but I can give them no hopes that such a thing can ever be produced. The emperor Charles V in the year 1524 granted to Dr. Stockamar, of Nuremberg, the privilege of using blue wax in seals: a favour like that conferred, in 1704, on the manufactories in the principality of Halberstadt and the county of Reinstein, to make indigo from minerals. It was, certainly, as difficult for the doctor to find blue wax for seals, as for the proprietors of these manufactories to discover indigo in the earth.*

Much later are impressions made on paste or dough, which perhaps could not be employed on the ancient parchment or the linen covers of letters, though in Pliny's time the paper then in use was joined together with flour paste.† Proper diplomas were never sealed with wafers; and in the matchless diplomatic collection of H. Gatterer there are no wafer seals much above two hundred years old. From that collection I have now in my possession one of these seals, around the impression of which is the following inscription, *Secretum civium in Ulma,* 1474; but it is only a new copy of a very old impression. Kings, however, before the invention of sealing-wax, were accustomed to seal their letters with this paste.*

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* Ceruleæ ceræ licet nullus fere usus sit, refert tamen Diether ad Besold, voce *wax,* Carolum V Imp. doctori Stockhamero Norimbergensi anno 1524 privilegium tali cera utendi dedisse. *J. M. Heineccii Syntagma de veteribus sigillis.* Francof. et Lips. 1719. fol. p. 55.

† Farina, qua chartæ glutinantur. Plin. lib. xxii. c. 25.

Heineccius and others relate that *maltha* also was employed for seals. This word signifies a kind of cement, formed chiefly of inflammable substances, and used to make reservoirs, pipes, &c. water-tight. Directions how to prepare it may be found in the writers on agriculture, Pliny, Festus, and others. The latter tells how to make it of a composition of pitch and wax: † but neither in that author nor in any other have I found proofs that letters were sealed with it, or that seals of it were affixed to diplomas; for the words of Pollux *cera qua tabella judicum obliniebatur*, ‡ will admit of a different explanation. If *maltha* has been, in reality, used for seals, that mixture may be considered as the first or oldest sealing-wax, as what of it is still preserved has been composed of resinous substances.

Some writers § assert, upon the authority of Lebeuf ||, that sealing-wax was invented about the

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* Trotz, Not. in prim. scribendi origine, p. 73, 74.

† *Maltha* dicitur a Græcis pix cum cera mixta. *Festi et Flacci de verb. sig.* lib. xx. edit. Dacerii, Lut. Par. 1681. 4to. p. 224. Hesichius calls this cement μεμαλγμένον κηρὸν. Pallad. lib. i. c. 17. Plin. lib. xxxvi. c. 24.

‡ Lib. viii. c. 4.

§ Nouveau traité de diplomatique, par deux Religieux Bénédictins. Paris 1759. 4to. iv. p. 33.

|| Memoires concernant l'histoire d'Auxerre, par Lebeuf. Paris 1743. ii. p. 517.

year 1640, by a Frenchman named Rousseau; but that author refers his readers to Papillon,[*] who refers again to Pomet,[†] so that the last appears to be the first person who broached that opinion. According to his account Francis Rousseau, born not far from Auxerres; who travelled a long time in Persia, Pegu, and other parts of the East Indies; and who in 1692 resided in St. Domingo, was the inventor of sealing-wax. Having, while he lived at Paris as a merchant, during the latter years of the reign of Louis XIII, who died in 1643, lost all his property by a fire, he bethought himself of preparing sealing-wax from gum lac, as he had seen it prepared in India, in order to maintain his wife and five children. A lady, of the name of Longueville, made this wax known at court, and caused Louis XIII to use it; after which it was purchased and used throughout all Paris. By this article Rousseau, before the expiration of a year, gained 50,000 livres. It acquired the name of *cire d'Espagne*, Spanish wax, because at that time a kind of gum lac, which was only once melted, and coloured a little red, was called Portugal wax, *cire de Portugal.*[‡]

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[*] Bibliotheque des auteurs de Bourgogne, par l'abbé Papillon. Dijon 1745. 2 vol. fol. ii. p. 217.

[†] Histoire générale des drogues, par le Sieur Pomet. Paris 1735. 2 vol. 4to. ii. p. 44. i. p. 28.

[‡] This Rousseau appears also in the History of cochineal, as he sent to Pomet a paper on that subject, which was contradicted by the

That sealing-wax was either very little or not at all known in Germany, in the beginning of the sixteenth century, may be concluded from its not being mentioned either by Porta or Wecker; though in the works of both these authors there are various receipts respecting common wax, and little-known methods of writing and sealing.* The former says, that to open letters, in such a manner as not to be perceived, the wax seal must be heated a little, and must be then carefully separated from the letter by a horse's hair; and when the letter has been read and folded up, the seal must be again dexterously fastened to it. This manœuvre, as the writers on diplomatics remark, has been often made use of to forge public acts; and they have, therefore, given directions how to discover such frauds.† The above method of opening letters, however, can be applied only to common wax, and not to sealing-wax: had the

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well-known Plumier, in the *Journal des Scavans* for 1694. He is mentioned also by Labat, who says he saw him at Rochelle; but at that time he must have been nearly a hundred years of age.

* Mr. Von Murr, in his learned *Beschreibung der merkwürdigkeiten in Nürnberg*, Numb. 1778, 8vo. p. 702, says, that Spanish wax was not invented, or at least not known, before the year 1559. This appears also from a manuscript of the same year, which contains various receipts in the arts and medicine. There are some in it for making the common white sealing-wax green or red.

† Quod si in sigillo antiquiori prætenso reperiatur adhuc sua ceræ pinguedo, magnaque hinc ejusdem vel aliqualis saltem mollities et tractabilitas; signum est sigillum tale partum esse supposititium ævi

latter been used in Wecker's time, he would have mentioned this limitation.*

Whether sealing-wax was used earlier in the East Indies than in Europe, as the French think, I cannot with certainty determine. Tavernier,† however, seems to say that the gum lac produced in the kingdom of Asem is employed there not only for lackering, but also for making Spanish sealing-wax. I must confess also that I do not know whether the Turks and other eastern nations use it, in general. In the collection of natural curiosities belonging to our university, there are two sticks of sealing-wax which professor Butner procured from Constantinople, under the name of Turkish wax. They are angular, bent like a bow, are neither stamped nor glazed, and are of a dark but pure red colour. Two other sticks which came from the

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sequioris. Pari quoque ratione, si pars sigilli posterior, qua diplomati annexum antiquitus sigillum extitit, simile vel pinguedinis vel mollitiei et tractabilitatis signum præ se ferat, cum facies anterior reliquas habet genuinæ ætatis antiquitatisque suæ notas et characteres: dubium vix remanet, sigillum ex antiquiori diplomate desumptum, et a manu recentiori sigillo alteri annexum fuisse. *Chronic. Godvic.* p. 102.

* Wecker gives directions also to make an impression with calcined gypsum, and a solution of gum or isinglass. Porta knew that this could be done to greater perfection with amalgam of quicksilver; an art employed even at present.

† Tavernier, in his Travels, says, that in Surat gum lac is melted, and formed into sticks like sealing-wax. Compare with this *Dappers Asia oder Ausführliche beschreibung*, &c. Nuremberg, 1681. fol. p. 237.

East Indies are straight, glazed, made somewhat thin at both ends, have no stamp, and are of a darker and dirtier red colour. All these four sticks seem to be lighter than ours, and I perceive that by rubbing they do not acquire so soon, nor so strong, an electrical quality as our German wax of moderate fineness. But whether the first were made in Turkey and the latter in the East Indies; or whether the whole four were made in Europe, is not known. That sealing-wax, however, was made and used in Germany a hundred years before Rousseau's time, and that the merit of that Frenchman consisted, probably, only in this, that he first made it in France, or made the first good wax, will appear in the course of what follows.

The oldest known seal of our common sealing-wax is that found by Mr. Roos, on a letter written from London, Aug. 3d, 1554, to the rheingrave Philip Francis von Daun, by his agent in England, Gerrard Herman.* The colour of the wax is a dark red; it is very shining, and the impression bears the initials of the writer's name G. H. The next seal, in the order of time, is one of the year 1561, on a letter written to the council of Gorlitz at Breslau. This letter was found among the ancient records of Gorlitz by Dr. Anton, and is three times sealed with beautiful red wax.* Among the archives of the before-mentioned family Mr. Roos found two other letters of the year 1566, both addressed to the rheingrave Frederick von Daun, from Orchamp in Picardy, by his steward Charles de Pousol; the one dated September the 2d, and the other September the 7th. Another letter, written by the same person to the same rheingrave, but dated Paris January 22d, 1567, is likewise sealed with red wax, which is of a higher colour, and appears to be of a coarser quality. As the oldest seals of this kind came from France and England, Mr. Roos conjectures that the invention, as the name seems to indicate, belongs to the Spaniards. This conjecture appears to me, however, improbable, especially as sealing-wax was used at Breslau so early as 1561; but this matter can be best determined, perhaps, by the Spanish literati. It is much to be lamented that John Fen, in his Original letters of the last half of the fifteenth century,† when he gives an account of the size and shape of the seals, does not inform us of what substances they are composed. Respecting a letter of the year 1455 he says, only,

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* Bruchstücke betreffend die beobachtung der pflichten eines staatsdieners; aus den handlungen des Raths Dreitz, nebst bemerkungen vom ältesten gebrauche des Spanischen siegelwachses—Frankfort on the Mayne 1785. 4to. p. 86; where the use of these antiquarian researches is illustrated by examples worthy of notice.

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* Historische untersuchungen gesamlet von J. G. Meusel, i. 3. p. 240.

† Original letters written during the reign of Henry VI. London 1787. 2 vol. 4to. i. p. xxi. and p. 87 and 92.

"The seal is of red wax;" by which is to be understood, undoubtedly, common wax.

Among the records of the landgraviate of Cassel, Mr. Ledderhose found two letters of count Louis of Nassau to the landgrave William IV, one of which, dated March the 3d, 1563, is sealed with red wax, and the other, dated November 7th, the same year, is sealed with black wax.* Mr. Neuberger, private keeper of the archives at Weymar, found among the records of that duchy a letter sealed with red wax, and written at Paris, May the 15th, 1571, by a French nobleman named Vulcob, who the year before had been ambassador from the king of France to the court of Weymar. It is worthy of remark, that the same person had sealed nine letters of a prior date with common wax, and that the tenth is sealed with Spanish wax.† Mr. P. L. Spiess, principal keeper of the records at Plessenburg, who gave rise to this research by his queries, saw a letter of the year 1574 sealed with red sealing-wax, and another of the year 1620 sealed with black sealing-wax. He found also in an old expense-book, of 1616, that Spanish wax, expressly, and other materials for writing were ordered from a manufacturer of sealing-wax at Nuremberg, for the personal use of Christian margrave of Brandenburg.‡

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* Der Geschichtforscher, published by Meusel. Halle. 8vo. vi. p. 270.

† Geschichtforscher, iv. p. 251.

‡ Ibid.

The oldest mention of sealing-wax which I have hitherto observed in printed books, is in the well-known work of Garcia ab Orto,* where the author remarks, speaking of gum lac, that those sticks used for sealing letters were made of it. This book was first printed in 1563, about which time it appears that the use of sealing-wax was very common among the Portuguese.

The oldest printed receipt for making sealing-wax was found by Mr. von Murr, in a work by Samuel Zimmerman, citizen of Augsburg, printed in 1579.† The copy which I have from the library of our university is signed at the end by the author himself. His receipts for making red and green sealing-wax I shall here transcribe.

" To make hard sealing-wax, called Spanish " wax, with which if letters be sealed they cannot " be opened without breaking the seal: Take " beautiful clear resin, the whitest you can procure, " and melt it over a slow coal fire. When it is " properly melted, take it from the fire, and for " every pound of resin add two ounces of cinnabar " pounded very fine, stirring it about. Then let

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* Halleri Bibliotheca botan. i. p. 332. *Aromatum et simplicium aliquot historia, Garcia ab Horto auctore.* Antverpiæ 1574. 8vo. p. 33. Ex ea bacilli illi, quibus in obsignandis epistolis utimur, conficiuntur.

† The whole title is: New Titularbuch,—sambt etlichen hinzugethanen gehaimnüssen und künsten, das lesen und die schreiberey betreffendt. Durch Samuelen Zimmerman, burger zu Augspurg. 4to. 1579. p. 112.

" the whole cool, or pour it into cold water. " Thus you will have beautiful red sealing-" wax.

" If you are desirous of having black wax, add " lamp-black to it. With smalt or azure you may " make it blue; with white-lead white, and with " orpiment yellow.

" If instead of resin you melt purified turpen-" tine, in a glass vessel, and give it any colour " you choose, you will have a harder kind of seal-" ing-wax, and not so brittle as the former."

What appears to me worthy of remark in these receipts for sealing-wax is, that there is no mention in them of gum lac, which, at present, is the principal ingredient, at least in that of the best quality; and that Zimmerman's sealing-wax approaches very near to that which, in diplomatics, is called *maltha*. One may almost conclude, therefore, that this invention was not brought from the East Indies.

The expression Spanish wax is of little more import than the words Spanish-green, Spanish-flies, Spanish-grass, Spanish-reed, and several others, as it was formerly customary to give to all new things, particularly those which excited wonder, the appellation of Spanish; and, in the like manner, many foreign or new articles have been called Turkish; such as Turkish wheat, Turkish paper, &c.

Respecting the antiquity of wafers, Mr. Spiess has made an observation,* which may lead to further researches, that the oldest seal with a red wafer, he has ever yet found, is on a letter written by D. Krapf, at Spires, in the year 1624, to the government at Bayreuth. Mr. Spiess has found also, that some years after Forstenhäusser, the Brandenburg factor at Nuremberg, sent such wafers to a bailiff at Osternohe. It appears, however, that wafers were not used during the whole of the seventeenth century, in the chancery of Brandenburg, but only by private persons, and by these even seldom; because, as Spiess says, people were fonder of Spanish wax. The first wafers with which the chancery of Bayreuth began to make seals were, according to an expense account of the year 1705, sent from Nuremberg. The use of wax, however, was still continued; and among the Plassenburg archives there is a rescript of 1722, sealed with proper wax. The use of wax must have been continued longer in the duchy of Weymar; for in the *Electa juris publici* there is an order of the year 1716, by which the introduction of wafers in law matters is forbidden, and the use of wax commanded. This order, however, was abolished by duke Ernest Augustus in 1742, and wafers again introduced.

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* Archivische nebenarbeiten und nachrichten, geliefert von Phil. Ernest Spiess. Halle 1785. 4to. ii. p. 3.

CORN-MILLS.

If under this name we comprehend all those machines, however rude, employed for pounding or grinding corn, these are of the highest antiquity. We read in the Scriptures, that Abraham caused cakes to be baked for his guests of the finest meal;[*] and that the manna was ground like corn.[†] The earliest instrument used for this purpose seems to have been the mortar; which was retained a long time even after the invention of mills properly so called, because these, perhaps, at first were not attended with much superior advantage.[‡] It appears, that, in the course of time, the mortar was made ridged and the pestle notched, at least at the bottom; by which means the grain was rather grated than pounded. A passage of Pliny,[*] not yet sufficiently cleared up, makes this conjecture probable. When a handle was added to the top of the pestle, that it might be more easily driven round in a circle, the mortar was converted into a hand-mill. Such a mill was called *mola trusatilis, versatilis, manuaria*,[†] and was very little different from those used at present by apothecaries, painters, potters, and other artists, for grinding coarse bodies, such as colours, glass, chalk, &c.[‡] We have reason to suppose that in every family there was a mill of this kind. Moses forbade them to be taken in pawn; for that, says he, is the same thing as to take a man's life to pledge. Michaelis, on this passage, observes that a man could not then grind, and, consequently, could not bake bread for the daily use of his family.[§] Grinding was at first the employment of the women, and particularly of the female slaves, as it is at present among uncivilised nations, and must therefore have required little strength; * but afterwards the mills were driven by bondsmen, around whose necks was placed a circular machine of wood, so that these poor wretches could not put their hands to their mouths, or eat of the meal.†

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[*] Genesis, ch. xviii. v. 6.

[†] Numbers, ch. xi. v. 8.

[‡] Ὀλμον μεν τριποδην ταμνειν, ὑπερον δε τριπηχυν.
Hesiod. Opera et Dies, 421.
Mortarium quidem tripedale seca, pistillum vero tricubitale.
It appears, therefore, that both the mortar and pestle were then made of wood, and that the former was three feet in height; but, to speak the truth, it is not here expressly said that this mortar was for the purpose of pounding corn. The mortar was called ὁλμος, pila; the pestle ὑπερος, or ὑπερον, pistillus or pistillum; to pound, μασσειν, pinsere, which word, as well as *pinsor*, was afterwards retained when mills came to be used. *Servius ad Virg. Æn.* i. 179. Majores molarum usum non habebant. Frumenta torrebant, et ea in pilas missa pinsebant, et hoc erat genus molendi. Unde et pinsores dicti sunt, qui nunc pistores vocantur. *Plin.* lib. xviii. c. 3.

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[*] Pistura non omnium facilis; quippe Etruria spicam farris tosti pisente pilo præferrato, fistula serrata et stella intus denticulata, ut nisi intenti pisant, concidantur grana, ferrumque frangatur. Major pars Italiæ ruido utitur pilo. *Plin.* xviii; 10. ii. p. 111. This passage Gesner has endeavoured to explain, in his Index to the *Scriptores rei rusticæ*, p. 59. to which he gives the too dignified title of *Lexicon rusticum.*

[†] Plautus ob quærendum victum ad circumagendas molas, quæ trusatiles appellantur, operam pistori locasset. *Gellius*, iii. c. 3.

[‡] Those not acquainted with these mills may see *Hartwig* (*Sprengels*) *Handwerke und Künste*, xiii. p. 125. plate 4, fig. 12. and *Wallerius*, *Physische chemie*, i. p. 62.

[§] Deuteronomy, ch. xxiv. v. 6.

In the course of time, shafts were added to the mill, that it might be driven by cattle, which were, as at present, blindfolded.‡ The first cattle-mills, *molæ jumentariæ,* had, perhaps, only a heavy pestle like the hand-mills;§ but it must have been soon remarked that the labour would be more speedily accomplished if, instead of the pestle, a large heavy cylindrical stone should be employed. I am of opinion, however, that the first cattle-mills had not a spout or a trough as ours have at present; at least the hand-mills which Tournefort* saw at Nicaria, and which consisted of two stones, had neither; but the meal which issued from between the stones, through an opening made in the upper one, fell upon a board or table, on which the lower stone, that was two feet in diameter, rested.

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* When Moses threatened Pharaoh with the destruction of the first-born in the land of Egypt, he said, "All the first-born shall "die, from the first-born of Pharaoh that sitteth on the throne, even "unto the first-born of the maid-servant that is behind the mill." *Genesis*, ch. xi. v. 5. See *Homeri Odyss.* vii. 103, and xx. 105.

† This machine by Pollux is called *παυσικαπη*.

‡ Apuleii Metamorph. lib. ix.

§ The oldest cattle-mills have, in my opinion, resembled the oil-mills represented in plate 25th of *Sonnerats Reise nach Ostindien und China*, i. Zurich 1783. 4to. To the pestle of a mortar made fast to a stake driven into the earth, is affixed a shaft to which two oxen are yoked. The oxen are driven by a man, and another stands at the mortar to push the seed under the pestle. Sonnerat says, that with an Indian hand-mill two men can grind no more than sixty pounds of meal in a day; while one of our mills, under the direction of one man, can grind more than a thousand.

The upper mill-stone was called *meta*, or *turbo;* and the lower one *catillus.* *Meta* signified also a cone with a blunt apex ;† and it has on that account been conjectured that corn was at first rubbed into meal by rolling over it a conical stone flatted at the end, in the same manner as painters, at present, make use of a grinding-stone; and it is believed that the same name was afterwards given to the upper mill-stone. This conjecture is not improbable, as some rude nations still bruise their corn by grinding-stones.‡ I do not, however, remember any passage in the ancients that mentions this mode of grinding: and I am of opinion that the pestle of the hand-mill, for which the upper mill-stone was substituted, may, on account of its figure, have been also called *meta.* Niebuhr§ found in Arabia, besides hand-mills, some grinding-stones, which differed from those used by us in their consisting not of a flat, but of an oblong hollow stone, or trough, with a pestle, which was not conical, but shaped like a spindle, thick in the middle and pointed at both ends. In this stone the corn, after being soaked in water, was ground to meal, and then baked into cakes.

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* Voyage du Levant. Amsterd. 1718. 4to. p. 155.

† A haycock was called *meta fœni.* Colum. ii. 19. Plin. xxvii. 28.

‡ Voyage de Frezier, p. 62.

§ Niebuhrs Beschreibung von Arabien. Copenhagen 1772. 4to. p. 31. A figure of both stones is represented in the first plate, fig. H.

Respecting the figure and construction of the ancient hand-mills, I expected to find some information from engraved stones, and other remains of antiquity; but my researches would have proved fruitless had not professor Diez, to whose memory and erudition I am much indebted, pointed out to me the only figure of one remaining. I say the only one remaining with the more confidence, as Mr. Heyne tells us also that he remembers no other. Anthony Francis Gori* has described a red jasper, on which is engraved the naked figure of a man, who in his left hand holds a sheaf of corn, and in the right a machine that in all probability is a hand-mill. Gori considers the figure as a representation of the god Eunostus, who, as Suidas says,† was the god of mills. The machine, which Eunostus seems to exhibit, or to be survey-ing himself, is, as far as one can distinguish (for the stone is scarcely half an inch in size), shaped like a chest, narrow at the top, and wide at the bottom. It stands upon a table, and in the bottom there is a perpendicular pipe from which the meal, represented also by the artist, appears to be issuing. Above, the chest or body of the mill has either a top with an aperture, or perhaps a basket sunk into it, from which the corn falls into the mill. On one side, nearly about the middle of it, there projects a broken shank, which, without overstraining the imagination, may be considered as a handle, or that part of the mill which some called *molile.* Though this figure is small, and though it conveys very little idea of the internal construction, one may, however, conclude from it that the roller, whether it was of wood or of iron, smooth or notched, did not stand perpendicularly, like those of our coffee-mills, but lay horizontally; which gives us reason to conjecture a construction more ingenious than that of the first invention. The axis of the handle had, perhaps, within the body of the mill, a crown-wheel, that turned a spindle, to the lower end of the perpendicular axis of which the roller was fixed. Should this be admitted, it must be allowed also, that the hand-mills of the ancients had not so much a resemblance to the before-mentioned colour-mills as to the philosophical mills of our chemists; and Langelott, consequently, will not be the real inventor of the latter.* On the other side, opposite to that where the handle is, there arise from the mill of Eunostus two shafts, which Gori considers as those of a besom and a shovel, two instruments used in grinding; but as the interior part cannot be seen, it appears to me doubtful whether these may not be parts of the mill itself.

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* Memorie di varia erudizione della Societa colombaria Fiorentina. In Livorno 1752. 4to. vol. ii. p. 207. Osservazioni del proposto A. F. Gori, sopra un' antica gemma anulare rappresentante Eunosto dio de mulini.

† Ευνοϛος ϑεος τις φασιν επιμυλιος. Eunostus, deus quidam, ut aiunt, molarum præses.

The remains of a pair of old Roman mill-stones were found in the beginning of the last century at Adel in Yorkshire, a description of which was given by Thornsby,† in the Philosophical Transactions. One of the stones was twenty inches in breadth; thicker in the middle than at the edges, and consequently convex on one side. The other was of the same form, but had that thickness at the edges which the other had in the middle, and some traces of notching could be observed upon it.

I shall not here collect all those passages of the ancients which speak of hand- and cattle-mills, because they have been already collected by others, and afford very little information.‡ Neither shall

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* See Wallerius Physische chemie, i. p. 62. fig. 73.

† Philosoph. Transact. n. 282, p. 1285, and Philos. Trans. from the year 1700 to the year 1720, abridged by Henry Jones, London 1731. ii. p. 38.

‡ Joh. Heringii Tractatus de molendinis eorumque jure. Francofurti 1663. 4to. *A very confused book, which requires a very patient reader.* F. L. Gœtzius de pistrinis veterum. Cygneæ 1730. 8vo. *Ex-*

I inquire to what Ceres the Grecians ascribed the invention of mills;* who Milantes was, to whom that honour has been given by Stephanus; † or how those mills were constructed which were first built by Myletes the son of Lelex, king of Laconia. ‡ Such researches would be attended with little advantage. I shall proceed, therefore, to the invention of water-mills.

These appear to have been introduced in the time of Mithridates, Julius Cæsar, and Cicero. Because Strabo§ relates that there was a water-mill near the residence of Mithridates, some have ascribed the honour of the invention to him; but

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tracted chiefly from the former, equally confused, and filled with quotations from authors who afford very little insight into the history or knowledge of mills. Traité de la police, par De la Mare. G. H. Ayrer de molarum initiis. Prolusio de molarum progressibus; *by the same.* Gottingen 1742. C. L. Hohciselii Diss. de molis manualibus veterum. Gedani 1728. Pancirollus, edit. Salmuth. ii. p. 294. Histoire de la vie privée des François, par Le Grand d'Aussy. Paris 1782. i. p. 33. See Fabricii Bibliographia antiq. Hamburgi 1760, p. 1002.

* Ceres frumenta instituit; eadem molere et conficere in Attica; et alia in Sicilia ob id dea judicata. *Plin.* lib. vii. c. 56.

† Stephan. de urbibus, v. μυλαντια.

‡ Μύλητα τὸν Λέλεγος ϖρῶτον ἀνθρώπων μυλην τε ἑυρειν λεγοντες και εν ταῖς Αλεσιαις ταύταις αλέσαι. Pausan. Lacon. iii. c. 20. edit. Kuhnii. p. 260.

§ Strabo, lib. xii. edit. Almelov. p. 834. In the Greek stands the words ὑδραλέτης, perhaps an ἁπαξ λεγόμενον, which the scholiasts have explained by a water-mill. In many translations of Strabo that word is wanting. As for example, in the Latin edition of Amsterdam, by John Janson the younger, 1652, 2 vol. 12mo. ii. p. 196.

nothing more can with certainty be concluded from this circumstance, than that water-mills were at that period known, at least in Asia. We are told by Pomponius Sabinus, in his remarks upon a poem of Virgil called *Moretus*, that the first mill seen at Rome was erected on the Tiber, a little before the time of Augustus; but of this he produces no proof. As he has taken the greater part of his remarks from the illustrations of Servius, and must have had a much completer copy of that author than any that has been printed, he may have derived this information from the same source.* The most certain proof that Rome had water-mills in the time of Augustus is the description which has been given of them by Vitruvius,† and the pretty epigram of Antipater: "Cease "your work, ye maids, ye who laboured in the "mill; sleep now, and let the birds sing to the "ruddy morning; for Ceres has commanded the "water-nymphs to perform your task: these, "obedient to her call, throw themselves on the "wheel, force round the axle-tree, and by these "means the heavy mill." This Antipater,* as Salmasius with great probability asserts, lived in the time of Cicero. Palladius † also speaks

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* This Pomponius Sabinus, author of a Commentary on the works of Virgil, is called also Julius Pomponius Lætus, though in a letter he denies that he is the author. He died in 1496. A good account of him may be found in *Fabricii Biblioth. mediæ et infimæ Latinitatis*, iv. p. 594, and in *Giornale de' litterati d'Italia*, vol. xxii. p. 336. Of his Commentary I have two editions before me, from the library of our university. *Julii Pomponii Sabini in omnia quæ quidem extant Vergilii Mar. Opera commentarii, nunc primum in lucem editi.* Basiliæ 1544. 8vo. *Vergilii Opera cum variorum commentariis, studio L. Lucii.* Basiliæ (1613.) fol. Where the poet gives an ingenious description of a hand-mill, Pomponius adds: Usus molarum ad manum in Cappadocia inventus; inde inventus usus earum ad ventum et ad equos. Paulo ante Augustum molæ aquis actæ Romæ in Tiberi primum factæ, tempore Græcorum, cum fornices diruissent.

† Fiunt etiam in fluminibus rotæ eisdem rationibus, quibus supra scriptum est. Circa earum frontes affiguntur pinnæ, quæ cum percutiuntur ab impetu fluminis, cogunt progredientes versari rotam; et

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ita modiolis aquam haurientes et in summum referentes, sine operarum calcatura, ipsius fluminis impulsu versatæ, præstant quod opus est, ad usum. Eadem ratione etiam versantur hydraulæ, in quibus eadem sunt omnia, præterquam quod in uno capite axis habent tympanum dentatum et inclusum; id autem ad perpendiculum collocatum in cultrum, versatur cum rota pariter. Secundum id tympanum, majus item dentatum planum est collocatum, quo continetur axis, habens in summo capite subscudem ferream, qua mola continetur. Ita dentes ejus tympani, quod est in axe inclusum, impellendo dentes tympani plani, cogunt fieri molarum circinationem, in qua machina impendens infundibulum subministrat molis frumentum, et eadem versatione subigitur farina. Lib. x. c. 10.

We learn from this passage, that the ancients had wheels for raising water, which were driven by being trod upon by men. That condemnation to these machines was a punishment, appears from *Artemidorus*, lib. i. c. 50, and *Sueton. Vita Tiber.* cap. 51. Uno ex his equestris ordinis viro et in antliam condemnato.

* This Greek epigram was first made known by Saumaise, in his Annotations on the Life of Heliogabalus by Lampridius. See *Historiæ Augustæ scriptores recensiti, a C. Salmasio.* Parisiis 1620. fol. p. 193. It is to be found also in *Mémoires de l'Académie des inscriptions*, ii. p. 315, and in *Analecta veterum Græcorum*, edit. Brunk. ii. p. 119. epig. 39.

† Si aquæ copia est, fusuras balnearum debent pistrina suscipere; ut ibi formatis aquariis molis, sine animalium vel hominum labore,

with equal clearness of water-mills, which he advises to be built on possessions that have running water, in order to grind corn without men or cattle.

There are also other passages of the ancients which are commonly supposed, but without certain grounds, to allude to water-mills. Among these is the following verse of Lucretius:[*]

> Ut fluvios versare rotas atque haustra videmus.

It appears also that the water-wheels to which Heliogabalus caused some of his friends and parasites to be bound,[†] cannot be considered as mills. These, as well as the *haustra* of Lucretius, were machines for raising water, like those mentioned in the before quoted passage of Vitruvius.[‡] It is,

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frumenta frangantur. *Pallad. de re rustica,* lib. i. 42. edit. Gesn. ii. p. 892.

[*] Lucret. v. 517. Compare Salmas. ad Solin. p. 416.

[†] Parasitos ad rotam aquariam ligabat, et cum vertigine sub aquas mittebat rursusque in summum revolvebat, eosque Ixionios amicos vocavit. *Lamprid. in Vita Heliogabali.*

[‡] Among the doubtful passages is one of Pliny, lib. xviii. c. 10, the beginning of which has been quoted already: Major pars Italiæ ruido utitur pilo; rotis etiam, quas aqua verset obiter, et molat. So reads Hardouin: but the French translator of Pliny divides these words otherwise, and reads thus: Major pars Italiæ ruido utitur pilo, rotis etiam quas aqua verset; obiter et molit; which he translates as follows: *Dans le majeure partie de l'Italie, on se sert d'un pilon raboteux, ou de roues que l'eau fait tourner; et par fois aussi on y emploie la meule.* Histoire naturelle de Pline, traduite en François. Paris 1771 and following years, 11 vol. 4to. vi. p. 349, and b. vii. ch. 56, note 6. This explanation is, in my opinion, very proper,

however, evident that there were water-mills at Rome at this period; and it affords matter of surprise that we do not find mention oftener made of them, and that they did not entirely banish the use of the laborious hand- and cattle-mills. That this was not the case, and that the latter were very numerous for some time after, may be concluded from various circumstances. When Caligula, about twenty-three years after the death of Augustus, took away all the horses and cattle from the mills, in order to transport effects of every kind which he had seized, there arose a scarcity of bread at Rome; from which Beroaldus justly infers that water-mills must have been then very rare. * Nay, more than three hundred years after Augustus, cattle-mills were so common at Rome, that their number amounted to three hundred.† Mention of them, and of the hand-

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Pliny is not speaking here of the labour of grinding corn, but that of freeing it from the husks, or of converting it into grits. For this purpose a mortar was used, the pestle of which could be so managed that the grain remained whole; but water-wheels were sometimes employed also. I agree with Le Prince (*Journal des Sçavans* 1779, Septem.) who thinks that Pliny here certainly speaks of a water-mill.

* In Gallia quoque cum damnatarum sororum ornamenta, et supellectilem, et servos, atque etiam liberos, immensis prætiis vendidisset: invitatus lucro, quidquid instrumenti veteris aulæ erat, ab urbe repetiit: comprehensis ad deportandum meritoriis quoque vehiculis, et pistrinensibus jumentis: adeo ut et panis Romæ sepe deficeret. *Sueton. Vita Calig.* cap. 39.

† Petr. Victor. de regionibus urbis Romæ.

mills always occurs, therefore, for a long time after in the laws. The Jurist Paulus, who lived about the year 240, particularizing the bequest of a baker, mentions *asina molendaria* and *mola*, a mill-ass and a mill.* In the year 319 Constantine ordered that all the slaves condemned to the mills should be brought from Sardinia to Rome.† Such orders respecting mill-slaves occur also under Valentinian.‡ When by the introduction of Christianity, however, the morals of men became improved, slaves were less frequent; and Ausonius, who lived under Theodosius the Great, about the end of the third century, expressly says, that in his time the practice had ceased of condemning criminals to slavery, and of causing mills to be driven by men.

Public water-mills, however, appear for the first time under Honorius and Arcadius; and the oldest laws which mention them, about the year 398, show clearly that they were then a new establishment, which it was necessary to secure by the support of government; and the orders for that purpose were renewed and made more severe by Zeno towards the end of the fifth century.* It is worthy of remark, that in the whole code of Justinian one does not find the least mention of wooden pales or posts, which occur in all the new laws; and which, when there were several mills situated in a line on the same stream, occasioned so many disputes.† The mills at Rome were erected on those canals which conveyed water to the city; and because these were employed in several arts, and for various purposes, it was ordered that by dividing the water the mills should be always kept going. The greater part of them lay under Mount Janiculum;‡ but, as they were driven by so small a quantity of water, they probably executed very little work; and for this reason, but chiefly on account of the great number of slaves, and the cheap rate at which they were maintained, these noble machines were not so much used, nor were so soon brought to perfection as they might have been. It appears, however, that after the abolition of slavery they were much improved and more employed; and to this a particular incident seems, in some measure, to have contributed.

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* Digestorum lib. xxxiii. tit. 7, 18, Cum de lanionis.

† Cod. Theodos. lib. ix. tit. 40, 3, or l. 3, Quicunque. C. Th. de poenis.

‡ Cod. Theodos. lib. xiv. tit. 3, 7, or l. 7, Post quinquennii, C. Th..de pistoribus. At present there are no other mills in Sardinia than such as are driven by asses. See *Francesco Cetti, Quadrupedi di Sardegna*. Sessati 1778. 8vo.

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* Cod. Theodos. lib. xiv. tit. 15, 4; and Cod. Justin. lib. xi. tit. 42, 10. Many things relating to the same subject may be found in Cassiodorus—Dicitur, commodi causa privati, aquam formarum, quam summo deceret studio communiri, ad aquæ molas exercendas vel hortos irrigandos fuisse derivatam. Turpe hoc et miserabile in illa urbe fieri, quod per agros vix deceret assumi. *Cassiodori Opera.* Genevæ 1650. 4to. p. 104.

† See J. M. Biler, Diss. de arbore et palo molinario. Halæ 1730. 4to.

‡ Procopius, Gothicorum, lib. i. c. 9.

> Quæ regio gradibus vacuis jejunia dira
> Sustinet? aut quæ Janiculi mola mota quiescit?
> *Prudentius contra Symmachum*, lib. ii. v. 948.

It is added in a note on this passage: Janiculus mons est ubi templum Jani erat, et multæ molæ constructæ. Compare *R. Fabretti Diss. tres de aquis et aquæductibus veteris Romæ*, n. 347, p. 176. See also *Grævii Thesaur. Antiq. Rom.* iv. p. 1677.

When Vitiges, king of the Goths, besieged Belisarius in Rome, in the year 536, and caused the fourteen large expensive aqueducts to be stopped, the city was subjected to great distress; not through the want of water in general, because it was secured against that inconvenience by the Tiber; but by the loss of that water which the baths required, and, above all, of that necessary to drive the mills, which were all situated on these canals. Horses and cattle, which might have been employed in grinding, were not to be found: but Belisarius fell upon the ingenious contrivance of placing boats upon the Tiber, on which he erected mills that were driven by the current. This experiment was attended with complete success; and as many mills of this kind as were necessary were constructed. To destroy these, the besiegers threw into the stream logs of wood, and dead bodies, which floated down the river into the city; but the besieged, by making use of booms, to stop them, were enabled to drag them out before they could do any mischief.* This seems to be the invention of floating-mills, at least I know of no other. It is certain that, by these means, the use of water-mills became very much extended; for floating-mills can be constructed almost upon any stream, without forming an artificial fall; they can be stationed at the most convenient places, and they rise and fall of themselves with the water. They are, however, attended with these inconveniences, that they require to be strongly secured; that they often block up the stream too much, and move slowly, and that they frequently stop when the water is too high, or when it is frozen.

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* The account of Procopius, in the first book of the War of the Goths, deserves to be here given at length. "When these aqueducts were cut off by the enemy, as the mills were stopped for want of water, and as cattle could not be found to drive them, the Romans, closely besieged, were deprived of every kind of food (for with the utmost care they could scarcely find provender for their horses). Belisarius, however, being a man of great ingenuity, devised a remedy for this distress. Below the bridge, which reaches to the walls of Janiculum, he extended ropes well fastened, and stretched across the river from both banks. To these he affixed two boats of equal size, at the distance of two feet from each other, where the current flowed with the greatest velocity, under the arch of the bridge, and placing large mill-stones in one of the boats, suspended in the middle space a machine by which they were turned. He constructed, at certain intervals, on the river, other machines of the like kind, which being put in motion by the force of the water that ran below them, drove as many mills as were necessary to grind provisions for the city, &c." See the Latin translation of Procopius, Basil 1531. fol. p. 44. The same account may be found in *Leonardi Aretini lib.* i. *de bello Italico adversus Gothos*; which has been copied by Joh. Magnus in *Historia de omnibus Gothorum Suenonumque regibus.* Romæ 1554. fol. p. 376.

After this improvement the use of water-mills was never laid aside or forgotten: they were soon made known all over Europe; and were it worth the trouble, one might quote passages in which they are mentioned in every century. The Roman, Salic, and other laws* provided security for these mills, which they call *molina* or *farinaria*; and define a punishment for those who destroy the sluices, or steal the mill-irons (*ferramentum*). But there were water-mills in Germany and France a hundred years before the Salic laws were formed. Ausonius, who lived about the year 379, mentions some which were then still remaining on a small stream that falls into the Moselle, and which were noticed also by Fortunatus,* in the fifth century. Gregory of Tours, who wrote towards the end of the sixth century, speaks of a water-mill which was situated near the town of Dijon; and of another which a certain abbot caused to be built for the benefit of his convent.† Brito, who in the beginning of the thirteenth century wrote in verse an account of the actions of Philip Augustus king of France, ‡ relates how by the piercing of a dam the mills near Gournay (*castrum Gornacum* or *Cornacum*) were destroyed, to the great detriment of the besieged. In the first crusade, at the end of the eleventh century, the Germans burned in Bulgaria seven mills, which were situated below a bridge on a small rivulet, and which seem to have been floating mills.[*] In deeds of the twelfth and thirteenth century, water-mills are often called *aquimollia, aquimoli, aquismoli, aquimolæ.*[†] Petrus Damiani, one of the fathers of the eleventh century, says, *Sicut aquimolum nequaquam potest sine gurgitis inundantia frumenta permolere, ita,* &c.[‡]

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* Si quis ingenuus annonam in molino furaverit - - - - Si quis sclusam de farinario alieno ruperit - - - - Si quis ferramentum de molino alieno furaverit - - - - *Leges Francorum Salicæ*, edit. Eccardi, Francof. et Lipsiæ 1720. fol. p. 51. *Sclusa* is translated *sluice*, and there is no doubt that the French word *escluse* is derived from it. All these words come from *schliessen* to shut up, or the Low Saxon *schluten*: but by that word, in these laws, we can hardly understand those expensive works which we at present call sluices, but probably wickets and what else belonged to the dam. *Lex Wisigothorum*, lib. viii. tit. 4, 30, may serve further to illustrate this subject: De confringentibus molina et conclusiones aquarum. Si quis molina violenter effregerit, quod fregit intra triginta dies reparare cogatur.—Eadem et de stagnis, quæ sunt circa molina conclusiones aquarum, præcipimus custodire. The *sclusæ* are here called *conclusiones aquarum*, to which belong also the mounds or dykes. See *Corpus juris Germanici antiqui*, ed. Georgisch. Halæ 1738. 4to. p. 2097. Gregory of Tours calls them in a passage which here follows *exclusas*. But what is *ferramentum*? The iron-work of our mills cannot be so easily stolen as to render it necessary to secure them by particular laws.

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* Præcipiti torquens cerealia saxa rotatu.
Auson. Mosella, v. 362.

Ducitur in rigidis sinuosa canalibus unda,
Ex qua fert populo hic mola capta cibum.
Venantii Hon. Clement. Fortunati Carmina, edit. Broweri, Moguntiæ 1617. 4to. p. 83.

† Fluviolus ante portam molendinas mira velocitate divertit. *Gregorii Turonensis Opera*, ed. Theod. Ruinart. Lutet. Paris. 1699. fol. Hist. lib. iii. 19. p. 126.——Dum Ursus abbas hæc ageret, ac fratres molam manu vertentes triticum ad victus necessarium comminuerent, pro labore fratrum visum est ei molendinum in ipso Angeris fluvii alveo stabilire; defixisque per flumen palis, aggregatis lapidum magnorum acervis exclusas fecit, atque aquam canale collegit, cujus impetu fabricæ rotam in magna volubilitate vertere fecit; hoc opere laborem monachorum relevans, atque uni fratrum delegans, opus necessarium implebatur. *Ibid.* Vita patrum, 18. p. 1242.

‡ Gul. Britonis Philippidos libri xii. editi a C. Barthio. Cygneæ 1657. 4to. lib. vi. v. 220. p. 115.

At Venice and other places, there were mills which righted themselves by the ebbing and flowing of the tide, and which every six hours changed the position of the wheels.[§] Zanetti[||] has shown, from some old charters, that such mills existed about the year 1044; and with still more certainty in 1078, 1079, and 1107. In one charter are the words: *Super toto ipso aquimolo molendini posito in*

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[*] Septem molendinis, quæ sub ponte in flumine degebant, ignem submiserunt. *Chronicon Hierosolymitanum,* edit. a Reinero Reineccio. Helmstadii 1584. 4to. lib. i. c. 10. p. 7.

[†] See Glossarium novum ad scriptores medii ævi, collegit Carpentier. Parisiis 1766. fol. vol. i. p. 266. In a chronicle written in the year 1290, a floating mill is called *molendinum navale,* also *navencum*; and in another chronicle of 1301, *molendinum pendens.* See also *Glossarium manuale,* tom. iv. Halæ 1776. 8vo. p. 721.

[‡] Damiani Opera omnia, edit. Cajetani. Parisiis 1743. fol. tom. i. p. 105. lib. vi. epist. 23.

[§] A new invention of this kind may be seen in *The Advancement of Arts, Manufactures, and Commerce,* by W. Bailey. Lond. 1772. fol. In English such a mill is called a *tide-mill.*

[||] Girolano Zanetti dell' origine di alcune arti principali appresso i Veneziani libri due. Venezia 1758. 4to. p. 71.

palude juxta campo alto; where the expression *aquimolum molendini* deserves to be particularly remarked, as it perhaps indicates that the mill in question was a proper grinding-mill. Should this conjecture be well founded, it would prove that so early as the eleventh century water-mills were used not only for grinding corn, but for many other purposes.

It appears that hand- and cattle-mills were every where still retained at private houses a long time after the erection of water-mills. We read in the Life of St. Benedict, that he had a mill with an ass, to grind corn for himself and his colleagues. Among the legendary tales of St. Bertin, there is one of a woman who, because she ground corn on a fast-day, lost the use of her arm; and of another whose hand stuck to the handle, because she undertook the same work at an unseasonable time. More wonders of this kind are to be found at later periods in the Popish mythology. Such small mills remained long in the convents; and it was considered as a great merit in many ecclesiastics, that they ground their own corn in order to make bread. The real cause of this was, that as the convents were entirely independent of every person without their walls, they wished to supply all their wants themselves as far as possible; and as these lazy ecclesiastics had, besides, too little labour and exercise, they employed grinding as an amusement, and to enable them to digest better their ill-deserved food. Sulpicius Severus * gives an account of the mode of living of an Eastern monk, in the beginning of the fifth century, and says expressly that he ground his own corn. Gregory of Tours mentions an abbot who eased his monks of their labour at the hand-mill, by erecting a water-mill.† It deserves here to be remarked, that, in the sixth century, malefactors in France were condemned to the mill, as is proved by the history of Septimina the nurse of Childebert. ‡

The entrusting of that violent element water to support and drive mills constructed with great art, displayed no little share of boldness; but it was still more adventurous to employ the no less violent but much more untractable, and always changeable wind for the same purpose. Though the strength and direction of the wind cannot be any way altered, it has however been found possible to devise means by which a building can be moved in such a manner that it shall be exposed to neither more nor less wind than is necessary, let it come from what quarter it may.

It is very improbable, or much rather false, that the Romans had wind-mills, though Pomponius

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* Dialog. i. 2. edit. Hornii. Amstel. 1665. 8vo. p. 449.

† See Gregory of Tours, *ut supra.*

‡ Septimina vehementer cæsa, ac cauteriis accensis in facie vulnerata, ablatis omnibus quæ habebat, in Marilegium villam deducitur, ut scilicet, trahens molam, his quæ in gynæcio erant positæ, per dies singulos farinas ad victus necessarias præpararet. *Histor. Francorum,* lib. ix. 38. p. 462.

Sabinus affirms so, but without any proof.[*] Vitruvius,[†] where he speaks of all moving forces, mentions also the wind; but he does not say a word of wind-mills; nor are they noticed either by Seneca [‡] or Chrysostom, [§] who have both spoken of the advantages of the wind. I consider as false also, the account given by an old Bohemian annalist,[||] who says that before the year 718 there were none but wind-mills in Bohemia, and that water-mills were then introduced for the first time. I am of opinion that the author meant to have written *hand- and cattle-mills* instead of *wind-mills*.

It has been often asserted, that these mills were first invented in the East, and introduced into Europe by the crusaders; but this also is improbable. For mills of this kind are not at all, or very seldom, found in the East. There are none of them in Persia, Palestine, or Arabia, and even water-mills are there uncommon, and constructed on a small scale. Besides, we find wind-mills before the crusades, or at least at the time when they were first undertaken. It is probable that these buildings may have been made known to a great part of Europe, and particularly in France and England,[*] by those who returned from these expeditions; but it does not thence follow, that they were invented in the East.[†] The crusaders perhaps saw such mills in the course of their travels through Europe; very probably in Germany, which is the original country of most large machines. In the like manner, the knowledge of several useful things has been introduced into Germany by soldiers who have returned from different wars; as the English and French, after their return from the last war, made known in their respective countries many of our useful implements of husbandry, such as our straw-chopper, scythe, &c.

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[*] See Pomponius Sabinus, *ut supra*.

[†] Lib. ix. c. 9. lib. x. c. 1, 13.

[‡] Natur. quæst. lib. v. c. 18.

[§] Chrysost. in psalm. cxxxiv. p. 362.

[||] At the same period (718) one named Halek the son of Uladi, the weak, built close to the city an ingenious mill which was driven by water. It was visited by many Bohemians, in whom it excited much wonder, and who taking it as a model, built others of the like kind here and there on the rivers; for before that time all the Bohemian mills were wind-mills, erected on mountains. *Wenceslai Hagecii Chronic. Bohem.* translated into German by John Sandel. Nuremberg 1697. fol. p. 13.

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[*] See De la Mare, Traité de la police, &c. *ut supra.* Description du duché de Bourgogne. Dijon 1775. 8vo. i. p. 163. Dictionnaire des Origines, par d'Origny, v. p. 184. The last work has an attracting title, but it is the worst of its kind, written without correctness or judgment, and without giving authorities.

[†] There are no wind-mills at Ispahan, nor in any part of Persia. The mills are all driven by water, by the hand, or by cattle. *Voyages de Chardin.* A Rouen 1723. 8vo. viii. p. 221.—The Arabs have no wind-mills; these are used in the East only in places where no streams are to be found; and in most parts the people make use of hand-mills. Those which I saw on Mount Lebanon and Mount Carmel had a great resemblance to those which are found in many parts of Italy. They are exceedingly simple, and cost very little. The mill-stone and the wheel are fastened to the same axis. The wheel, if it can be so called, consists of eight hollow boards, shaped like a shovel, placed across the axis. When the water falls with violence upon these boards it turns them round and puts in motion the mill-stone, over which the corn is poured. *Darvieux, Merkwürdige nachrichten von seinen reisen.* Part iii. Copenhagen and Leipsic 1754. 8vo. p. 201.—I did not see either water- or wind-mills in all Arabia. I, however, found an oil-press at Tehama, which was driven by oxen; and thence suppose that the Arabs have corn-mills of the like kind. *Niebuhr, Beschreibung von Arabien,* p. 217.

Mabillon mentions a diploma of the year 1105, in which a convent in France is allowed to erect water- and wind-mills, *molendina ad ventum.** In the year 1143, there was in Northamptonshire an abbey, situated in a wood, which in the course of 180 years was entirely destroyed. One cause of its destruction was said to be, that in the whole neighbourhood there was no house, wind- or water-mill built, for which timber was not taken from this wood.† In the twelfth century, when these mills began to be more common, a dispute arose whether the tythes of them belonged to the clergy; and pope Celestine III determined the question in favour of the church.[*] In the year 1332, one Bartolomeo Verde proposed to the Venetians to build a wind-mill. When his plan had been examined, a piece of ground was assigned to him, which he was to retain in case his undertaking should succeed within a time specified.[†] In the year 1393, the city of Spires caused a wind-mill to be erected, and sent to the Netherlands for a person acquainted with the method of grinding by it.[‡] A wind-mill was also constructed at Francfort in 1442, but I do not know whether there had not been such there before.[§]

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* Iisdem etiam facultatem concessit constituendi domos, stagna, molendina ad aquam et ventum, in episcopatu Ebroicensi, Constantiensi et Bajocensi, ad augendos monasterii proventus. *Mabillon, Annales Ordinis S. Benedicti.* tom. v. Lut. Paris. 1713. fol. p. 474.

† Præterea non fuit in patria, aula, camera, orreum, molendinum venticium sive aquaticum alicujus valoris plantata sine adminiculo aliquo boscorum Sanctæ Mariæ de Pipewalla (so the wood was called). Et quot virgæ molendinorum venticiorum dabantur in temporibus diversorum abbatum nemo novit, nisi Deus. Caussa tertia destructionis boscorum fuit in constructione et emendatione domorum infra abbathiam et extra, utpote in grangiis, orreis, bercariis, molendinis aquaticis et venticiis per vices.——The letter of donation, which appears also to be of the twelfth century, may be found in the same collection, vol. ii. p. 459. In it occurs the expression *molendinum ventriticum.*

To turn the mill to the wind, two methods have been invented. The whole building is constructed in such a manner as to turn on a post below, or the roof alone, together with the axle-tree, and the

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In a charter also in vol. iii. p. 107. we read of *molendinum ventorium*. *Monasticon Anglicanum, sive Pandectæ Coenobiorum,* edit. sec. Lond. 1682. fol. i. p. 816.

[*] De reditibus molendini ad ventum solvendæ sunt decimæ. *Decretal Greg.* lib. iii. tit. 30. c. 23.

[†] Gir. Zanetti dell' origine di alcune arte appresso i Veneziani. Venez. 1758. 4to. p. 74. Pro faciendo unum molendinum a vento. *Le Bret, Geschichte von Venedig,* ii. 1. p. 233.

[‡] Lehmanns Chronica der Stadt Speyer. Frankf. 1662. 4to. p. 847. "Sent to the Netherlands for a miller who could grind with "the wind-mill."

[§] Lersner, Frankf. Chronik. ii. p. 22.

wings are moveable. Mills of the former kind are called German-mills, those of the latter Dutch. They are both moved round either by a wheel and pinion within, or by a long lever without.[*] I am inclined to believe, that the German-mills are older than the Dutch; for the earliest descriptions which I can remember, speak only of the former. Cardan,[†] in whose time wind-mills were very common both in France and Italy, makes however no mention of the latter; and the Dutch themselves affirm, that the mode of building with a moveable roof was first found out by a Fleming in the middle of the sixteenth century.[‡] Those mills, by which in Holland the water is drawn up and thrown off from the land, one of which was built at Alkmaar in 1408, another at Schoonhoven in 1450, and a third at Enkhuisen in 1452, were at first driven by horses, and afterwards by wind.

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[*] Descriptions and figures of both kinds may be found in Leupold's *Theatrum machinarum generale*. Leipzig 1724. fol. p. 101. tab. 41, 42, 43.

[†] Nor can I pass over in silence what is so wonderful, that before I saw it I could neither believe nor relate it, though commonly talked of, without incurring the imputation of credulity. But a thirst for science overcomes bashfulness. In many parts of Italy, therefore, and here and there in France, there are mills which are turned round by the wind. *De rerum varietate*, lib. i. cap. 10. in the edition of all his works, Lugduni 1663. fol. vol. iii. p. 26.

[‡] This account I found in *De koophandel van Amsterdam, door Le Long*. Amst. 1727. 2 vol. 8vo. ii. p. 584. *De beweegelyke kap, om de moolens op all winden te zetten, is eerst in't midden van de* xvide.

But as these mills were immoveable, and could work only when the wind was in one quarter, they were afterwards placed not on the ground, but on a float which could be moved round in such a manner that the mill should catch every wind.* This method gave rise perhaps to the invention of moveable mills.

It is highly probable, that in the early ages men were satisfied with only grinding their corn, and that in the course of time they fell upon the invention of separating the meal from the pollard or bran. This was at first done by a sieve moved with the hands; and even yet in France, when what is called *mouture en grosse* is employed, there is a particular place for bolting, where the sieve is moved with the hand by means of a handle. It is customary also in many parts of Lower Saxony and Alsace, to bolt the flour separately; for which pur-

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eeuw door een Vlaaming uytgevonden. "The moveable top for "turning the mill round to every wind was first found out in the "middle of the sixteenth century by a Fleming." We read there that this is remarked by John Adrian Leegwater; but of this man I know nothing more than what is related of him in the above work, that he was celebrated on account of various inventions, and died in 1650, in the seventy-fifth year of his age. See also *Beschryving der Stadt Delft, door verscheide Liefhebbers en Kenners der Nederlandsche oudheden.* Te Delft, 1729. fol. p. 623.

* De molens hadden doen (toen) vaste kappen, zoo datze maar met eene wind malen konde, waarom men op zekere plaats, om dit ongeval voor te kommen, een molen op een groot vlot neder zette, dat men dan naarden wind draide. See the *History of the city of Delft,* above quoted.

pose various sieves are necessary. The Romans had two principal kinds, *cribra excussoria* and *pollinaria*, the latter of which gave the finest flour, called *pollen*. Sieves of horse-hair were first made by the Gauls, and those of linen by the Spaniards.* The method of applying a sieve in the form of an extended bag to the works of the mill, that the meal might fall into it as it came from the stones, and of causing it to be turned and shaken by the machinery, was first made known in the beginning of the sixteenth century, as we are expressly told in several ancient chronicles.†

This invention gave rise to an employment which at present maintains a great many people; I mean that of preparing bolting-cloths, or those kinds of cloth through which meal is sifted in mills. As this cloth is universally used, a considerable quantity of it is consumed. For one bolting-cloth, five yards are required; we may allow, therefore, twenty-five to each mill in the course of a year. When this is considered, it will not appear improbable, that the electorate of Saxony, according to a calculation made towards the end of the 17th century, when manufactories of this cloth were established, paid for it yearly to foreigners from twelve to fifteen thousand rix-dollars. That kind of bolting-cloth also which is used for a variety of needle-work, for young ladies' samplers, and for filling up the frames of window-screens, &c. is wove after the manner of gauze, of fine-spun woollen yarn. One might imagine that this manufacture could not be attended with any difficulty; yet it requires many ingenious operations which the Germans cannot easily perform, and with which they are, perhaps, not yet perfectly acquainted. However this may be, large quantities of bolting-cloth are imported from England. It indeed costs half as much again per yard as the German cloth, but it lasts much longer. A bolting-cloth of English manufacture will continue good three months, but one of German will last scarcely three weeks. The wool necessary for making this cloth must be long, well washed, and spun to a fine equal thread, which, before it is scowered, must be scalded in hot water to prevent it from shrinking. The web must be stiffened; and in this the English have an advantage we have not yet been able to attain. Their bolting-cloth is stiffer as well as smoother, and lets the flour much better through it than ours, which is either very little or not at all stiffened. The places where this cloth is made are also not numerous. A manufactory of it was established at Ostra, near Dresden, by Daniel Kraft, about the end of the 17th century;* and to raise him a capital for carrying it on, every mill was obliged to pay him a dollar. Hartau, near Zittau, is indebted for its manufactory to Daniel Plessky, a linen-weaver of the latter, who learned the art of making bolting-cloth in Hungary, when on a visit to his relations, and was enabled to carry it on by the assistance of a schoolmaster named Strietzel. Since that period this business has been continued there, and become common.† The cloth which is sent for sale, not only every where around the country, but also to Bohemia, Moravia, and Silesia, is wove in pieces. Each piece contains from sixty-four to sixty-five Leipsic ells: the narrowest is ten, and the widest fourteen inches in breadth. A piece of the former costs at present from four to about four dollars and a half, and one of the latter six dollars. This cloth, it must be allowed, is not very white; but it is not liable to spoil by lying in warehouses. Large quantities of bolting-cloth are made also by a company in the duchy of Wurtemberg. At what time this art was introduced there, I cannot say: for every thing I know of it I am indebted to a friend, who collected for me the following information in his return through that country. The cloth is not wove in a manufactory, but by eighteen or twenty master-weavers, under the inspection of a company who pay them, and who supply all the materials. The company alone have the privilege of dealing in this cloth; and the millers must purchase from their agents whatever quantity they have occasion for.* The millers, however, choose rather, if they can, to supply themselves privately with foreign and other home-made bolting-cloth, as they complain that the weavers engaged by the company do not bestow sufficient care to render their cloth durable: besides, the persons employed to carry about this cloth for sale, often purchase secretly cloth of an inferior quality in other places, and sell it as that of the company. Bolting-cloth is made also at Gera as well as at Potsdam and Berlin; at the latter of which there is a manufactory of it carried on by the Jews.

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* Cribrorum genera Galli e setis equorum invenere, Hispani e lino excussoria et pollinaria. Ægyptus e papyro atque junco. *Plin.* lib. xviii. cap. 11.

† At midsummer 1502, machinery for bolting in mills was first introduced and employed at Zwikau; Nicholas Boller, who gave rise to this improvement, being then sworn master of the bakers' company. It may be thence easily seen, that coarse and not bolted flour, such as is still used in many places, and as was used through necessity here at Zwikau in 1641, was before that period used for baking. *Chronica Cygnea,* or *Description of the town of Zwikau, by Tobias Schmidten.* Zwikau 1656. v. vol. 4to. ii. p. 249. See also *Theatri Freibergensis Chronicon.* Pars posterior. Freyberg. 1653. 4to. p. 335. Anno 1580, a great drought and scarcity of water. Of all the mills near town there were only fifteen going; and in order that the people might be better supplied with meal, the bolting-machinery was removed, and this was attended with such good consequences that each mill could grind as much as before. In Walser's *Appenzeller Chronik. S. Gall.* 1740. 8vo. p. 471, we are told that about that time (1533) a freeman of Memmingen taught the people of Appenzel to make the beautiful white bolted flour so much and so far celebrated.

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* Some information respecting this manufacturer may be found in the second and fourteenth volumes of the *Leipziger Samlungen.*

† Transactions of the economical society at Leipsic, Michael-mas 1772. Dresden, 8vo. p. 79.

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* According to the general rescript of 1750, which has been often renewed. See *Das recht der handwerker nach Wirtembergischen gesetzen, entworfen von Weisser.* Stutgart 1779. 8vo. p. 220 and 377. This company obtained that exclusive right so early as the year 1668.

For some years past the French have so much extolled a manner of grinding called *mouture économique*, that one might almost consider it as a new invention, which ought to form an epoch in the history of the miller's art. This art, which however is not new, consists in not grinding the flour so fine at once as one may wish, and in putting the meal afterwards several times through the mill, and sifting it through various sieves. This method, which in reality has nothing in it either very ingenious or uncommon, was known to the ancient Romans, as we may conclude from the account of Pliny, who names the different kinds of meal, such a *similago*, *simila*, *flos*, *pollen*, *cibarium*, &c.; for these words are not synonymous, but express clearly all the various kinds of meal or flour which were procured from the same corn by repeated grinding and sifting. In general, the Romans had advanced very far in this art;* and they knew how to prepare from corn more kinds of meal, and from meal more kinds of bread, than the French have hitherto been able to obtain. Pliny[*]

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* One may easily perceive by what Pliny says, that the Romans had made a variety of observations and experiments on grinding and baking. By comparing his information with what we know at present, I have remarked two things, which, as they will perhaps be serviceable to those who hereafter may endeavour to illustrate Pliny, I shall lay before the reader. That author says, book xviii. ch. 9. *Quæ sicca moluntur plus farinæ reddunt; quæ salsa aqua sparsa, candidiorem medullam, verum plus retinent in furfure.* A question here arises, whether the corn was moistened before it was ground, and whether this was done with fresh or with salt water. If Pliny, as is probable, here means a thorough soaking, he is not mistaken; for it is certain that corn which has been exposed to much wet yields less meal, and that the meal, which is rather gray or reddish than white, will not keep long. The millers also are obliged, when corn

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has been much wetted, to put it through the mill oftener, because it is more difficult to be ground. See *J. C. Fulmann, Erfahrungen von der behandlung des zum vermahlen bestimten getreides.* Leipsic 1778. 8vo. p. 31. *Malouin, Backer-und Müller-Kunst,* the German translation in *Schauplatz der Künste,* viii. p. 113. and *Hanow Abhandlung von Getreidewagen, in Schriften der Naturforschenden geselschaft in Danzig,* i. p. 359. It is true also, that when salt water is used for moistening corn, the meal becomes clammier, and more difficult to be separated from the bran. It is well known that it is not proper to steep in salt water, malt which is to be ground for beer. On the other hand, a moderate soaking, which requires experience and attention, is useful, and is employed in preparing the finest kinds of flour, such as the Frankfort, Augsburg and Ulm spelt-meal, which is exported to distant countries. Many excellent rules on this subject are given by *Fullmann,* and also (*Reyher*) *Abhandlung von zubereitung der weissen starke.* Erfurt 1769. 8vo.

There is another passage in the tenth chapter of the same book of Pliny, where he seems to recommend a thorough soaking of corn that is to be ground. *De ipsa ratione pisendi Magonis proponetur sententia: triticum ante perfundi aqua multa jubet, postea evalli, deinde sole siccatum pilo repeti.* I am of opinion that we have here the oldest account of the manner of making meal; that is, by pounding. This appears to me probable from the words immediately preceding, which I have above endeavoured to explain, and from the word *evalli.* I do not think that it ought to be translated *to winnow* as Saumaise says, in *Exercitat. Plinianæ,* p. 907; but agree with Gesner in *Thesaur. Steph.* that it signifies to free the corn from the husk. The corn was first separated from the husks by pounding, which was more easily done after the grain had been soaked; the shelled corn was then soaked again, and by these means rendered so brittle, that it was easily pounded to meal. The like method is employed when people make grits without a mill, only by pounding; a process mentioned by Krünitz in his *Encyclopédie,* vol. ix. p. 805.

[*] Plin. lib. xviii. c. 10.

reckons that bread should be one-third heavier than the meal used for baking it; and that this was the proportion in Germany above a hundred years ago, is known from experiments on bread made at different times, which, however uncertain they may always have been, give undoubtedly more bread than meal.* In latter times, the arts of grinding and of baking have declined very much in Italy; and sensible Italians readily acknowledge that their bread is much inferior to that of most parts of Europe, and that in this respect the Germans are their masters.† Rome indeed forms an exception; for one can procure there as good bread as in Germany; but it is necessary to acquaint the reader, that it is not baked by Italians but by Germans; and all the bread and biscuit baked at Venice in the public ovens, either for home consumption, the use of shipping, or for exportation, is the work of German masters and journeymen. They are called to Venice expressly for that purpose; and at Rome they form at present a company, and have a very elegant church.* The ovens of these German bakers are seldom suffered to cool, and the greater part of the owners of them become rich; but as through avarice they often continue their labour, without interruption, in the greatest heat for several days and nights, scarcely one in ten of them lives to return with his wealth to Germany. The Germans have, it is certain, long supplied the inhabitants of proud Rome, the metropolis of Catholic Christendom, with bread; for in the fifteenth century it was customary in all the great families to use no other than German bread, as is very circumstantially related by Felix Fabri, a Dominican monk, who wrote about the end of the above century, and died in 1502.†

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* Farther information on this subject may be found collected in [illegible] *Krünitz, Encyclopédie*, vol. iii. p. 384. According to experiment[illegible] mentioned by Köhler in the appendix to his *Rechenmeister*, a hun[illegible] dred pounds of meal in Germany produce a hundred and fifty[illegible] pounds of dough, and these a hundred and fifty-three pounds eleven [illegible] and a half ounces of good bread.

† See the treatise of Rosa, professor of medicine at Pavia, on the [illegible] baking of bread in Lombardy, in *Atti dell' academia delle scienze* [illegible] *di Siena*, tom. iv. p. 321. Also *L'amico de poveri, che insegna il ver*[illegible] *modo di fare il pan venale.* In Firenze 1773. 8vo. See also *Ph*[illegible]*sikal-ökon, biblioth.* iv. 365, and v. p. 45.

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* Schlœzers Staatsanzeigen, i. numb. 2. p. 219.

† Italy, the most celebrated country in the world, and abundant in grain, has no delicate, wholesome and pleasant bread, but what is baked by a German baker, who, by art and industrious labour, subdues the fire, temperates the heat, and equalises the flour in such a manner, that the bread becomes light, fine and delicate; whereas, if baked by an Italian, it is heavy, hard, unwholesome and insipid. His holiness, therefore, prelates, kings, princes and great lords seldom eat any bread except what is baked in the German manner. The Germans not only bake well our usual bread, but they prepare also biscuit for the use of ships or armies in the time of war, with so much skill, that the Venetians have German bakers only in their public bake-houses; and their biscuit is sent far and wide over Illyria, Macedonia, the Hellespont, Greece, Syria, Egypt, Libya, Mauritania, Spain, France, and even to the Orkney Islands and Britain, to be used by their own seamen, or sold to other nations." *Historia Suevorum*, lib. i. c. 8. This history of Felix Fabri may be found in *Suevicarum rerum scriptores aliquot ex bibliotheca et recensione Goldasti*, printed for the first time at Francfort, 1605, 4to. and again at Ulm, 1727, fol.

The *mouture économique* has been long known in Germany. Sebastian Muller, in the beginning of the 17th century, gave so clear a description of it, that the French even acknowledge it.[*] This author says, that one Butré, who came to Germany to teach the Germans to grind and to bake, was not a little disconcerted when he found his scholars more expert than their officious master, and that he met with nothing to console him but that, according to his opinion, the mill-stones at Carlsruhe were too small, and that the bolting-sieves were not made in the same manner as those at Paris.[†]

Millers and bakers, even in France, practised sometimes this method of grinding so early as the sixteenth century; but it was some time forbidden by the police as hurtful. In the year 1546, those were threatened with punishment who should grind their corn twice;[‡] and in 1658 this threat was renewed, and the cause added, that such a practice was prejudicial to the health.[‖] Such prohibitions,

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[*] Bericht von brodtbacken, fundiret und gerichtet auf die substanz, natur, eigenschaft und güttigkeit des fruchtwachs, gestellet durch Sabaldum Mullern, burgern zu Konigsberg in Preussen. Leipsig 1616, 4to. nebst einigen tabellen. Muller's work is published also in *Arcana et curiositates œconomicæ*, or Curious secrets respecting domestic œconomy, collected by David Maiern, 1706, 8vo. the place where printed not mentioned.

[†] Schreber, in his Observations on Malouin, shows that the mill-stones in France are too large.

[‡] Traité de la police, par De la Mare, ii. p. 259.

[‖] Défenses sont aussi faites à tous boulangers, tant maîtres que forains, de faire remoudre aucun son, pour par après en faire et fabriquer du pain, attendu qu'il seroit indigne d'entrer au corps hu-

however, made by the police without sufficient grounds, could not prevent intelligent persons from remarking that the bran still contained meal, which, when separated from it, would be as proper for food as the first. Those who had observed this were induced by the probability of advantage, to try to separate the remaining meal from the bran; and the attempt was attended with success, but it was necessary to keep it concealed. Malouin relates, that, above a hundred years before, a miller at Senlis employed this method, and that the same practice was generally, though privately, introduced at all the mills in the neighbourhood. There were people who made a trade of purchasing bran in order to separate it from the meal, which they sold; and it is probable that many of them carried the art too far, and even ground bran along with the meal. This was done chiefly during times of scarcity, as in the year 1709. As men at that time were attentive to every advantage, this art was more known and more used, so that at length it became common. The clergy of the royal chapel

main, sur peine de quarante-huit livres Parisis d'amende. *De la Mare*, p. 228. The following was the true cause of this prohibition. As a heavy tax in kind was demanded for all the meal brought to Paris, many sent thither not meal, but bran abundant in meal, which they caused to be ground and sifted there, and by these means acquired no small gain. When the tax was abolished, an end was put to this deception, which would otherwise have brought the *mouture économique* much sooner to perfection.

and parish church at Versailles sent their wheat to be ground at an adjacent mill; it was, according to custom, put through the mill only once, and the bran, which still contained a considerable quantity of meal, was sold for fattening cattle. In time, the miller, having learned the *mouture économique*, purchased the bran from these ecclesiastics, and found that it yielded him as good flour as they procured from the whole wheat. The miller at length discovered to them the secret, and gave them afterwards fourteen bushels of flour from their wheat, instead of eight which he had given them before. This voluntary discovery of the miller was made in 1760, and it is probable that the art was disclosed by more at the same time. A baker named Malisset proposed to the lieutenant-général de police to teach a method, by which people could grind their corn with more advantage; and experiments were set on foot and published, which proved the possibility of it. A mealman of Senlis, named Buquet, who had the inspection of the mill belonging to the large hospital at Paris, made the same proposal; the result of his experiments, conducted under the direction of magistrates, was printed; the investigation of this art was now taken up by men of learning, who gave it a suitable name; and they explained it, made calculations on it, and recommended it so much, that the *mouture économique* engaged the attention of all the magistrates throughout France.[*] Government sent Buquet to Lyons in 1764, to Bourdeaux in 1766, to Dijon in 1767, and to Mondidier in 1768; and the benefit which France at present derives from this improvement is well worth that trouble. Before that period, a Paris *setier* yielded from eighty to ninety pounds of meal, and from one hundred and fifty to one hundred and sixty pounds of bran; but the same quantity yields now one hundred and eighty-five, and according to the latest improvements one hundred and ninety-five pounds of meal. In the time of St. Louis, from four to five setiers were reckoned necessary for the yearly maintenance of a man, and these even were scarcely sufficient; so many were allowed to the patients in the hospital aux Quinze-Vingts; and such was the calculation made by Budée in the sixteenth century.[†] When the miller's art was every where improved, these four *setiers* were reduced to three and a half, and after the latest improvements to two.[‡]

[*] Histoire de la vie privée des François, par M. Le Grand d'Aussy. Paris 1782, 3 vol. 8vo. i. p. 50.

[†] Budæus de asse. Basiliæ 1556. fol. p. 214.

[‡] The principal writers on the mouture économique are the following: *Mémoire sur les avantages de la mouture économique*, par B. Dijon 1769, 8vo. *Manuel de meunier, et charpentier de moulins; ou Traité de la mouture économique, redigé sur les mémoires du Sr. Cesar Buquet:* par M. Beguillet. Paris 1775, 8vo. *Traité de la connoissance générale des grains, et de la mouture par économie.* Par M. Beguillet, 1775, 2 vol. 8vo. *Pain économique*, par M. de Butré. Carlsruhe 1777, 8vo. *Le parfait boulanger*, par M. Parmentier. Paris 1778, 8vo. See Professor Beckman's Biblioth. x. 74, 79.

Mills by which grain is only freed from the husk and rounded, are called barley-mills, and belong to the new inventions. At first barley was prepared only by pounding, but afterwards by grinding; and as it was more perfectly rounded by the latter method, it was distinguished from that made by pounding by the name of pearl-barley. Barley-mills differ very little in their construction from meal-mills; and machinery for striking barley is generally added to the latter. The principal difference is that the mill-stone is rough-hewn around its circumference; and, instead of an under stone, has below it a wooden case, within which it revolves, and which, in the inside, is lined with a plate of iron pierced like a grater, with holes, the sharp edges of which turn upwards. The barley is thrown upon the stone, which, as it runs round, draws it in, frees it from the husk, and rounds it; after which it is put into sieves and sifted.* At Ulm, however, the well-known Ulm barley is struck by a common mill, after the stones have been separated a sufficient distance from each other.† The first kind of barley-mills is a German invention. In Holland the first was erected at Saardam not earlier than the year 1660. This mill, which at first was called the Pellikaan, scarcely produced in several years profit sufficient to maintain a family; but in the beginning of the last century there were at Saardam fifty barley-mills, which brought considerable gain to their proprietors.[*]

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* Beyers Theatrum machin. molar. p. 85. Sprengels Handwerke und künste, xii. p. 77.

† Schrebers Beyträge zur beförderung der haushaltungskunde. Munster 1776, 8vo. p. 230.

As long as the natural freedom of man continued unrestrained by a multiplicity of laws, every person was at liberty to build on his own lands and possessions whatever he thought proper, and not only water- but also wind-mills. This freedom was not abridged even by the Roman law.[†] But as it is the duty of rulers to consult what is best for the whole society under their protection, princes took care that no one should make such use of common streams as might impede or destroy their public utility.[‡] On this account, no individual was permitted to construct a bridge over any stream; and it is highly probable that the proprietors of land, when water-mills began to be numerous, restrained, from the same principle, the liberty of erecting them, and allowed them only, when after a proper investigation they were declared to be not detrimental. Water-mills, therefore, were included among what were called *regalia;* and among these they are expressly reckoned by the emperor Frederic I.[*] On small streams, however, which were not navigable, the proprietors of the banks might build mills every where along them.[†]

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[*] De pelmoolens zyn in Duytschlandt uytgevonden, waarvan de eerste omtrent den jaare 1660 op dit dorp is gebouwt, die men den naam van de Pellikaan gaf. Dese is'er veele jaaren alleen geweest; en't is aanmerkelyk dat toen voor een huysgesin daar mede naauwelyks de kost kon gewonnen worden; daar'er nu wel 50 zyn waar van de eygenaars alle rykelyk konnen bestaan. *De koophandel van Amsterdam, door Le Long.* 1727. ii. p. 538.

[†] Fluminum publicorum communis est usus, sicuti viarum publicarum et litorum. In his igitur publice licet cuilibet ædificare et destruere; dum tamen hoc sine incommodo cujusquam fiat. *Digestorum* lib. xxxix, tit. 2. 24.

[‡] Ait prætor: Ne quid in flumine publico ripave ejus facias, ne quid in flumine publico neve in ripa ejus immittas, quo statio iterve navigio deterior sit, fiat. *Digestor.* lib. xliii. tit. 12. 1.

The avarice of land-holders, favoured by the meanness and injustice of governments, and by the weakness of the people, extended this regality not only over all streams, but also over the air and wind-mills. The oldest example of this with which I am at present acquainted, is related by Jargow.* In the end of the fourteenth century, the monks of the celebrated but long since destroyed monastery of Augustines, at Windsheim, in the province of Overyssel, were desirous of erecting a wind-mill not far from Zwoll; but a neighbouring lord endeavoured to prevent them, declaring that the wind in that district belonged to him. The monks, unwilling to give up their point, had recourse to the bishop of Utrecht, under whose jurisdiction the province had continued since the tenth century. The bishop, highly incensed against the pretender who wished to usurp his authority, affirmed, that the wind of the whole province belonged to him only; and in 1391, gave the convent express permission to build a wind-mill wherever they thought proper.† In the like manner the city of Haerlem obtained leave from Albert count palatine of the Rhine to build a wind-mill in the year 1394.*

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[*] In C. L. Tolneri Codex diplomaticus Palatinus, printed with his Historia Palatina, Francof. ad Moen. 1700, fol. p. 54, there is a diploma of Frederic I, of the year 1159, which contains the following words; "Quia vero superius mentionem de regalibus fecimus, ne quis de eis dubitet, nominatim ea exprimimus. Hæc itaque regalia esse dicuntur: moneta, viæ publicæ, aquatilia, flumina, publica molendina, furni, forestica, &c." Much to the same purpose is a passage of Gunther's poem *Ligurinus,* which may be found in *Reuberi Scriptores veteres de rebus Cæsarum Germanicorum.* Francof. 1584, fol. p. 408.

> Postea sollicite regni de jure vetusto
> Quæstio mota fuit; quod desuetudine longa
> Priscus inumbrabat neglecti temporis error.
> Ac primum Ligures, super hoc a rege rogati,
> Vectigal, portus, cudendæ jura monetæ,
> Cumque molendinis, - - - - -
> Hæc Ligures sacro tribuerunt omnia fisco.

In *Reliquiæ manuscriptorum ex museo J. P. a Ludewig.* Francof. 1720. 8vo. ii. p. 200, we read an instance of the emperor Frederic I having forbidden the building of a mill.

[†] Non autem omne, quod in flumine publico ripave fit, coercet prætor; sed si quid fiat quo deterior statio et navigatio fiat. Ergo hoc interdictum ad ea tantum flumina publica pertinet quæ sunt navigabilia; ad cætera non pertinet. *Digestor.* lib. xliii. tit. 11, 12.

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* Jargow, Einleitung in die lehre von den regalien. Rostock 1757. 4to. p. 494.

† As our monastery had not a mill to grind corn, they resolved to build a new one. When the lord of Woerst heard this, he did every thing in his power to prevent it, saying, that the wind in Zealand belonged to him, and that no one ought to build a mill there without his consent. The matter, therefore, was referred to the bishop of Utrecht, who, as soon as the affair was made known to him, replied in a violent passion, that no one had power over the wind within his diocese but himself and the church at Utrecht; and he immediately granted full power, by letters patent, dated 1391, to the convent at Windsheim, to build for themselves and their successors a good wind-mill, in any place which they might find convenient. *Chronicon Canonicorum regularium ordinis Augustini, capituli Windesemensis; auctore Joh. Buschio.* Antverpiæ 1621. 8vo. p. 73.

Another restraint to which men in power subjected the weak, in regard to mills, was, that vassals were obliged to grind their corn at their lord's mill, for which they paid a certain value in kind. The oldest account of such ban-mills, *molendina bannaria*, occurs in the eleventh century. Fulbert, bishop of Chartres, and chancellor of France, in a letter to Richard duke of Normandy, complains that attempts began to be made to compel the inhabitants of a part of that province to grind their corn at a mill situated at the distance of five leagues.† In the chronicle of the Benedictine monk Hugo de Flavigny, who lived in the eleventh and twelfth century, we find mention of *molendina quatuor cum banno ipsius villæ*.‡ More examples of this servitude, *secta ad molendinum*, in the twelfth and thirteenth centuries, may be seen in Du Fresne, under the words *molendinum bannale*.

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* Albertus —— notum facimus —— quod donavimus donamusque—civitati nostræ Harlemianæ—ventum molarium a parte australi civitatis nostræ præscriptæ, Heemstadium versus, inter Pacis-fossam et Sparnam. *Theod. Schrevelii Harlemum*. Lugduni Batavorum 1647. 4to. p. 181.

† This letter of Fulbert may be found in *Maxima bibliotheca veterum patrum*. Lugduni 1677. fol. tom. xviii. p. 9.—quod Baldricus minister nostris hominibus novam angariam induxerit, banniendo scilicet ut irent ad molendinum sancti Audoeni, quinque leucis, ut fertur, ab eorum hospitiis remotum.

‡ Chron. Virodunense, in Labbei Biblioth. manuscr. i. p. 132.

It is not difficult to account for the origin of these ban-mills. When the people were once subjected to the yoke of slavery, they were obliged to submit to more and severer servitudes, which, as monuments of feudal tyranny, have continued even to more enlightened times. De la Mare[*] gives an instance where a lord, in affranchising his subjects, required of them, in remembrance of their former subjection, and that he might draw as much from them in future as possible, that they should agree to pay a certain duty, and to send their corn to be ground at his mill, their bread to be baked in his oven, and their grapes to be pressed at his wine-press. But the origin of these servitudes might perhaps be accounted for on juster grounds. The building of mills was, at all times, expensive, and undertaken only by the rich, who, to indemnify themselves for the money expended in order to benefit the public, stipulated that the people in the neighbourhood should grind their corn at no other mills than those erected by them. At present, when every method devised to prevent the deception of millers has been found insufficient, it e wished that these ban-mills were abo- that the number of free mills were increased.

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[*] Thomas, abbé de Saint Germain des Prez, sous le regne de Saint Louis accorda (la manumission ou affranchissement) aux habitans d'Antony, de Verrieres et de Massy, au mois de Juin 1248, à la charge de cent livres Parisis de rente, et des droits de bannalité : *ut coquant ad furna nostra, molant ad molendina, et premant ad torcularia nostra.* Ces sont les termes des patentes qui en furent expediées, et qui sont conservées dans les archives de cette abbaye. *Traités de la police*, ii. p. 151.

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VERDIGRISE, OR SPANISH GREEN.

RESPECTING the preparation of verdigrise, various and in part contradictory opinions have been entertained; and at present, when it is with certainty known, it appears that the process is almost the same as that employed in the time of Theophrastus, Dioscorides, and Vitruvius. *At that period, however, every natural green copper calx was comprehended under the name of *ærugo*. Dioscorides and Pliny say expressly, that a substance of the nature of those stones which yielded copper when melted, was scraped off in the mines of Cyprus; as is still practised in Hungary, where the outer coat of the copper ore is collected in the like manner, and afterwards purified by being washed in water.† Another species, according to the account of Dioscorides, was procured from the water of a grotto in the same island; and the most saleable natural verdigrise is still collected by a similar method in Hungary. The clear water which runs from old copper-works is put into large vessels, and after some time the green earth falls to the bottom as a sediment.*

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* Dioscorid. lib. v. cap. 91, 92. Theophrastus de lapidibus, edit. Hei[illegible] 399. Plin. lib. xxxiv. cap. 11, 12. Oribasius, Medic. colle[illegible] xiii. Stephani Medicæ artis-principes, p. 453. Vitruv. lib. vii. cap. 12.

† Bruckmann, Epistolæ itinerar. cent. i. p. 76.

The artificial *ærugo* of the ancients, however, was our verdigrise, or copper converted into a green calx by vinous acid. To discover the method of procuring this substance could not be difficult, as that metal contracts a green rust oftener than is wished, when in the least exposed to acids. The ancients, for this purpose, used either vessels and plates of copper, or only shavings and filings;† and the acid they employed was either the sourest vinegar,‡ or the sour remains left when they made wine: such as grapes become sour, or the stalks and skins after the juice had been pressed from them.§ Sometimes the copper was only exposed to the vapour of vinegar in close vessels, so that it did not come into immediate contact with the acid; in the same manner as was practised with plates of lead in the time of Theophrastus, when white-lead was made, and as is still practised at present. Sometimes the metal was entirely covered with vinegar, or frequently besprinkled with it, and the green rust was from time to time scraped off;[*] and sometimes copper filings were pounded with vinegar in a copper mortar, till they were changed into the wished-for green calx. This article was frequently adulterated, sometimes with stones, particularly pumice-stone reduced to powder, and sometimes with copperas.[†] The first deception was easily discovered; and to detect the second, nothing was necessary but to roast the verdigrise, which betrayed the iron by becoming red; or to add to the verdigrise some gall-nut, the astringent particles of which, united with the ferruginous vitriol of the copperas, formed an ink, which communicated a black colour to paper dipped into it.

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* Delius, Anleitung zur Bergbaukunst. Wien. 1773, 4to. p. 425.

† Dioscorides: λεπιδας ῥινισματα. Plinius: *Squamæ, delimata æris scobe.*

‡ Dioscorides: Οξος δριμυτατον.

§ Plinius: *vinacea.* Dioscorides: στεμφυλα. Theophrastus: τρυξ. The last word has various meanings: sometimes it signifies squeezed grapes; sometimes wine lees, &c. of which Niclas gives examples, in his Observations on *Geop.* lib. vi. c. 13. p. 457; but it c ever be translated by *amurca,* though that word is used by Furl the translator of Theophrastus. The old glossary says, Αμοργη, ν δε τρυξ ελαιου. Oil, however, has nothing to do with verdigr

In early periods verdigrise was used principally for making plasters, and for other medicinal purposes; but it was employed also as a colour, and on that account it is by Vitruvius reckoned among the pigments. When applied to the former purpose, it appears that the copper calx was mixed with variou ssalts and other ingredients. One mixture of this kind was called vermicular verdigrise,* the accounts of which in ancient authors seem to some commentators to be obscure; but in my opinion we are to understand by them, that the ingredients were pounded together till the paste they formed assumed the appearance of pieces or threads like worms; and that from this resemblance they obtained their name. For the same reason the Italians give the name of *vermicelli* to wire-drawn paste of flour used in cookery.† When the process for making this kind of verdigrise did not succeed, the workmen frequently added gum to it, by which the paste was rendered more viscous; but this mixture is censured both by Pliny and Dioscorides. It appears that the greater part of the verdigrise in ancient times was made in Cyprus, which was celebrated for its copper-works, and in the island of Rhodes.

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[*] This kind was called therefore ιος ξυστος, ærugo rasilis.

[†] Χαλκανθον, atramentum sutorium.

At present the greater part of our verdigrise is manufactured at Montpellier in France, and by processes more advantageous than those known to the ancients. The dried stalks of grapes are steeped in strong wine, and with it brought to a sour fermentation. When the fermentation has ceased, they are put into an earthen pot, in alternate layers with plates of copper, the surface of which, in a few days, is corroded by the vinous acid, and the calx is then scraped off.* The manufacturers of this article use only Swedish copper, for which they send to Hamburgh; and it is believed that no wine is so proper for the above purpose as that of Languedoc. However this may be, it is certain, that, even in the fifteenth century, the making of verdigrise was an old and profitable branch of commerce in France. The city of Montpellier having been obliged to expend large sums in erecting more extensive buildings to carry it on, and having had very small profits for some years before, received, by letters patent from Charles VI., in 1411, permission to demand sixteen sous for every hundred weight of verdigrise made there.† In latter times this trade has decayed very much. Between the years 1748 and 1755, from nine to ten thousand quintals were manufactured annually, by which the proprietors had a clear profit of 50,000 crowns; but a sudden change seems to have taken place, for in 1759 the quantity manufactured was estimated at only three thousand quintals. This quantity required 630 quintals of copper, valued at 78,750 livres: the expenses of labour amounted to 1,323 livres; the necessary quantity of wine, 1033 measures, to 46,485 livres, and extraordinaries to 10,330 livres; so that the three thousand quintals cost the manufacturers about 136,888 livres. In the year 1759, the pound of verdigrise sold for nine sous six deniers: so that the three thousand quintals produced 142,500 livres, which gave a neat profit of only 5612 livres.* Other nations, who till that period had purchased at least three-fourths of the French verdigrise, made a variety of experiments in order to discover a method of corroding copper by mineral acid, which might be cheaper; and some have so far succeeded that they can supply themselves without the French paint in cases of necessity. As one instance, I shall mention only the verdigrise manufactured by Gravenhorst and brothers at Brunswick.

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* Ιος σκωληξ, ærugo scolacea, *or* vermicularis.

† Should this explanation be just, we ought for *æruca*, the name given by Vitruvius to verdigrise, to read *eruca*: though the conjecture of Marcellus Vergilius (*Dioscorides, interprete Mar. Vergilio.* Coloniæ 1529. fol. p. 656), that the reading should be *ænea* or *ærea*, is no less probable; for by this epithet its difference from *ærugo ferri* was frequently distinguished.

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* The latest writers on this art are mentioned in Weigel's Chemie, p. 527. and Krünitz, Oekonom. Encycloped. xx. p. 241.

† This is mentioned by Serane in his treatise, a translation of which may be found in *Mineralogischen Belustigungen*, ii. p. 251.

In commerce there is a kind of this substance known under the name of distilled verdigrise, which properly is nothing else than verdigrise purified, and somewhat crystallized by being again dissolved in vinegar. This article has been hitherto manufactured by the Dutch, and affords an additional example of the industry of that people. Formerly, there was only one person at Grenoble acquainted with this art, which he kept secret and practised alone; but for some years past there have been three manufactories of the same kind at Montpellier, and another has been established at Paris by Baumé.*

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* Journal œconom. 1759. p. 311.

The German name of verdigrise (*spangrün*) has by most authors been translated Spanish green; and it has thence been concluded that we received that paint first from the Spaniards. This word and the explanation of it are both old; for we find *ærugo*, and *viride Hispanicum*, translated *Spangrün*, *Spongrün*, or *Spansgrün*, in many of the earliest dictionaries,† such as that printed in 1480.‡ For this meaning, however, I know no other proof than the above etymology, which carries with it very little probability; and I do not remember that I ever read in any other works that verdigrise first came from the Spaniards.

SAFFRON.

THAT the Latin word *crocus* signified the same plant which we at present call saffron, and which, in botany, still retains the ancient name, has, as far as I know, never been doubted; and indeed I know no reason why it should, however mistrustful I may be when natural objects are given out for those which formerly had the like names. The moderns often apply ancient names to things very different from those which were known under them by the Greeks and the Romans: but what we read in ancient authors concerning *crocus* agrees, in every respect, with our saffron, and can scarcely be applied to any other vegetable production. *Crocus* was a bulbous plant, which grew wild in the mountains. There were two species of it, one of which blowed in spring, and the other in autumn. The flowers of the latter, which appeared earlier than the green leaves that remained through the winter, contained those small threads or filaments which were used as a medicine and a paint, and employed also for seasoning various kinds of food.*

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* An account of the method of making distilled verdigrise may be found in the following works: *L'Art du distillateur d'eaux-fortes, par Demachy*. Paris 1773. fol. p. 168. *Mémoires de l'Academ. des Sciences à Paris, année* 1776. p. 724.

† Frisch's Worterbuch, p. 291. In the works of *George Agricola*, printed together at Basle 1546, fol. we find in page 473, where the terms of art are explained: *Ærugo*, Grünspan, or Spansch-grün, *quod primo ab Hispanis ad Germanos sit allata*; *barbari nominant* viride æris.

‡ By Conrad Zeninger Nuremberg. In that scarce work, *Josua Maaler, Teutsche Spraach* oder *Dictionarium Germano-Latinum*, Zurich 1561, 4to. *ærugo* is called Spangrüne.

It appears that the medicinal use, as well as the name of this plant, has always continued among the Orientals; and the Europeans, who adopted the medicine of the Greeks, sent to the Levant for saffron,* until they learned the art of rearing it themselves; and employed it very much until they were made acquainted with the use of more beneficial articles, which they substituted in its stead. Those who are desirous of knowing the pharmaceutical preparation of saffron, and the diseases in the curing of which it was employed, may read Hertodt's *Crocologia*, where the author has collected all the receipts, and even the simplest, for preparing it.†

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* Plin. lib. xxi. cap. 6. Geopon. lib. xi. cap. 26. and Theophrast. Histor. plant. lib. vi. cap. 6; where Joh. Bod. von Stapel, p. 661, has collected, though not in good order, every thing to be found in the ancients respecting saffron. The small aromatic threads, abundant in colour, the only parts of the whole plant sought after, were by the Greeks called γλωχινες, κροκιδες, or τριχες; and by the Romans *spicæ*. They are properly the end of the pistil, which is cleft into three divisions. A very distinct representation of this part of the flower may be seen in plate 184 of Tournefort's *Institut. rei herbariæ.*

What in the ancient use of saffron is most discordant with our taste, at present, is the employing it as a perfume. Not only were halls, theatres, and courts, through which one wished to diffuse an agreeable smell, strewed with this plant,‡ but it entered into the composition of many vinous extracts, which retained the same scent; and these costly smelling waters were often made to flow in small streams, which spread abroad their much-admired odour.§ Luxurious people even moistened or filled with them all those things with which they were desirous of surprising their guests in an agreeable manner,* or with which they ornamented their apartments. From saffron, with the addition of wax and other ingredients, the Greeks as well as the Romans prepared also scented salves, which they used in the same manner as our ancestors their balsams.†

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* On this account we often find in prescriptions: *Recipe croci Orientalis* - - - -

† Crocologia, seu curiosa croci enucleatio, congesta a J. F. Hertodt. Jenæ 1670 8vo.

‡ See Beroald's Observations on the 54th chapter of the Life of Nero by Suetonius. Spartian, in the Life of Adrian, chap. 19, says; Romæ post cæteras immensissimas voluptates in honorem socrus suæ, aromatica populo donavit. In honorem Trajani balsama et crocum per gradus theatri fluere jussit.

§ Lucan, in the ninth book of his Pharsalia, verse 809, describing how the blood flows from every vein of a person bit by a kind of ser-

Notwithstanding the fondness which the ancients showed for the smell of saffron, it does not appear that in modern times it was ever much esteemed. As a perfume, it would undoubtedly be as little relished at present as the greater part of the dishes of Apicius, fricassees of sucking puppies,‡ sausages, and other parts of swine, which one could not even mention with decency in gen-

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pent found in Africa, says, that it spouts out in the same manner as the sweet-smelling essence of saffron issues from the limbs of a statue.

> Utque solet pariter totis se effundere signis
> Corycii pressura croci; sic omnia membra
> Emisere simul rutilum pro sanguine virus.

* Omnes placentæ omniaque poma, etiam minima vexatione contacta, cœperunt effundere crocum. *Petron*. *Satyr*. cap. 60.

† Of the method of preparing this salve or balsam, mentioned by Athenæus, Cicero, and others, an account is to be found in Dioscorides, lib. i. c. 26.

‡ Catulos lactentes adeo puros existimabant ad cibum, ut etiam placandis numinibus hostiarum vice uterentur his. Genitæ Manæ catulo res divina fit, et in cœnis Deum etiamnum ponitur catulina. Aditialibus quidem epulis celebrem fuisse, Plauti fabulæ indicio sunt. *Plin*. lib. xxix. cap. 4. And Festus says: Catulinam carnem esitavisse, hoc est comedisse, Romanos, Plautus in Saturione refert.

teel company;* though it certainly has the same scent which it had in the time of Ovid, and although our organs of smelling are in nothing different from those of the Greeks and the Romans. From parts of the world to them unknown, we have, however, obtained perfumes which far excel any with which they were acquainted. We have new flowers, or, at least, more perfect kinds of flowers long known, which, improved either by art or by accident, are superior in smell to all those in the gardens of the Hesperides, of Adonis and Alcinous, so much celebrated. We have learned the art of mixing perfumes with oils and salts, in such a manner as to render them more volatile, stronger, and more pleasant; and we know how to obtain essences such as the ancient voluptuaries never smelt, and for which they would undoubtedly have given up their saffron. The smelling-bottles and perfumes which are often presented to our beauties, certainly far excel that promised by Catullus to a friend, with the assurance that his mistress had received it from Venus and her Cupids, and that when he smelt it he would wish to become all nose:

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* Martial, b. xiii. ep. 43, praises a cook who dressed the dugs of a sow with so much art and skill, that it appeared as if they still formed a part of the animal, and were full of milk:

> Esse putes nondum sumen; sic ubere largo
> Effluit, et vivo lacte papilla tumet.

A dish of this sort is mentioned by *Apicius de arte coquin.* lib. vii. cap. 2. The same author gives directions, book vii. chap. i. for cooking that delicious dish of which Horace says, ep. i. 15. 41, *nil vulva pulchrius ampla.* Further information on this subject may be found in the notes to Pliny's Epistles, lib. i. 15; *Plin.* lib. xi. c. 37; Martial. Epig. xiii. 56; and, above all, in *Joh. Pet. Lottichii Commentar. in Petronium,* lib. i. cap. 18.

> Nam unguentum dabo quod meæ puellæ
> Donarunt Veneres Cupidinesque,
> Quod tu quom olfacies, deos rogabis,
> Totum ut te faciant, Fabulle, nasum.

It cannot, however, be denied, that both taste and smell depend very much on imagination. We know that many articles of food, as well as spices, are more valued on account of their scarcity and costliness than they would otherwise be. Hence things of less value, which approach near to them in quality, are sought after by those who cannot afford to purchase them; and thus a particular taste or smell becomes fashionable. Brandy and tobacco were at first recommended as medicines; they were, therefore, much used, and by continual habit people at length found a pleasure in these sharp and almost nauseating articles of luxury. Substances which gratify the smell become, nevertheless, like the colour of clothes, oft unfashionable when they grow too common. Certain spiceries, in which our ancestors delighted, are insupportable to their descendants, whose nerves are weak and more delicate; and yet many of the present generation have accustomed themselves to strong smells of various kinds, by gradually using them more and more, till they have at length become indispensable wants. Some have taken snuff rendered so sharp by salts, antimony, sugar of lead, and other poisonous drugs, that the olfactory nerves have been rendered callous, and entirely destroyed by it.

That saffron was as much employed in seasoning dishes as for a perfume, appears from the oldest work on cookery which has been handed down to us, and which is ascribed to Apicius. Its use, in this respect, has been long continued, and, in many countries, is still more prevalent than physicians wish it to be. Henry Stephen says, “Saffron must be put into all Lent soups, sauces, “ and dishes: without saffron we cannot have “ well-cooked peas.*”

It may readily be supposed that the great use made of this plant in cookery must have induced people to attempt to cultivate it in Europe; and, in my opinion, it was first introduced into Spain by the Arabs, as may be conjectured from its name, which is Arabic, or rather Persian.† From

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* Le saffran doit être mis en tous les potages, sauces et viandes quadragésimales. Sans le saffran, nous n'aurions jamais bonne purée, bon pois passés, ni bonne sauce. *Apologie pour Herodote, par H. Estiene.* A la Haye 1735. 2 vol. 8vo.

† Meninski, in his Turkish Lexicon, p. 2448 of the old edition, has *Zae'feran,* crocus. Golius in his Dictionary gives it as a Persian word. That much saffron is still cultivated in Persia, and that it is of the best kind, appears from Chardin. See his Travels, printed

Spain it was, according to every appearance, carried afterwards to France, perhaps to Albigeois, and thence dispersed into various other parts.* Some travellers also may, perhaps, have brought bulbs of this plant from the Levant. We are, at least, assured that a pilgrim brought from the Levant to England, under the reign of Edward III, the first root of saffron, which he had found means to conceal in his staff, made hollow for that purpose.† At what period this plant began to be cultivated in Germany I do not know; but that this was first done in Austria, in 1579, is certainly false. Some say that Stephen von Hausen, a native of Nuremberg, who, about that time, accompanied the imperial ambassador to Constantinople, brought the first bulbs to Vienna, from the neigh-

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at Rouen 1723. 10 vol. 12mo. iv. p. 37. That the Spaniards borrowed the word *safran* from the Vandals is much more improbable. It is to be found in *Joh. Marianæ Histor. de rebus Hispaniæ*. Hagæ 1733. fol. i. p. 147. The author, speaking of foreign words introduced into the Spanish language, says, Vandalis aliæ voces acceptæ feruntur, *camara, azafran*, &c.

* Cours complet d'agriculture, redigé par Rozier, Paris 1781. 4to. i. p. 266.

† It is reported at Saffron-Walden, that a pilgrim, proposing to do good to his country, stole a head of saffron, and hid the same in his palmer's staff, which he had made hollow before on purpose, and so he brought this root into this realm, with venture of his life; for if he had been taken, by the law of the country from whence it came, he had died for the fact. *Voyages collected by Hakluyt*, vol. ii. p. 164. The same thing, extracted from *Harrison's History of Britain*, book iii. chap. 14, is related in *The Political Survey of Britain, by J. Campbell.* London 1774. 4to. ii. p. 191.

bourhood of Belgrade.* This opinion is founded on the account of Clusius, who, however, does not speak of the autumnal saffron used as a spice, but of an early sort, esteemed on account of the beauty of its flowers.† Clusius has collected more species of this plant than any of his predecessors; and has given an account by whom each of them was first made known.

In the fifteenth and following century, the cultivation of saffron was so important an article in the European husbandry, that it was omitted by no writer on that subject; and an account of it is to be found in Crescentio,‡ Serres,§ Heresbach,‖ Von Hohberg,¶ Florinus,** and others. In those periods, when it was an important object of trade, it was adulterated with various and in part noxious substances; and attempts were made in several countries to prevent this imposition by severe penalties. In the year 1550, Henry II, king of France, issued an order for the express purpose of preventing such frauds, the following extract from which will show some of the methods employed to impose on the public in the sale of this article:[*] "For some time past," says the order, "a certain quantity of the said saffron has been found "altered, disguised, and sophisticated, by being "mixed with oil, honey, and other mixtures, in "order that the said saffron, which is sold by "weight, may be rendered heavier; and some add "to it other herbs, similar in colour and substance "to beef over-boiled, and reduced to threads, "which saffron, thus mixed and adulterated, can"not be long kept, and is highly prejudicial to the "human body; which, besides the said injury, "may prevent the above-said foreign merchants "from purchasing it, to the great diminution of "our revenues, and to the great detriment of "foreign nations, against which we ought to pro"vide," &c.

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* Breslauer Samlung, 1720. November, p. 536.

† Sexta species primum Germaniæ innotuit post annum 1579, *Stephani van Hausen* Noribergensis diligentia, qui ejus anni initio Constantinopoli rediens in comitatu generosi viri *Ulrichi a Kunnigsperg* (qui præcedente anno honorarium eo tulerat) in Servia, sive Mœsia superiore, sub Belgrado florentem eruit, Martio mense. *Clusii Rar. plant. hist.* Antwerp 1601. fol. p. 207.

‡ Pietro Crescentio d'agricoltura. In Venetia 1542. 8vo. lib. vi. cap. 25.

§ Le théatre d'agriculture et mesnage des champs, d'Olivier de Serres. Seconde edit. Paris 1603. 4to. p. 662.

‖ Rei rusticæ libri quatuor, conscripti a Conr. Heresbachio. Spiræ Nemetum 1595. 8vo. p. 252.

¶ Georgica curiosa.

** Oeconomus prudens et legalis.

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[*] The whole order may be seen in *Traité de Police, par De la Mare*, iii. p. 428.

ALUM.

This substance affords a striking instance how readily one may be deceived in giving names without proper examination. Our alum was certainly not known to the Greeks or the Romans; and what the latter called *alumen* * was vitriol; not, however, pure vitriol, but such as forms itself in mines, and which is often nothing else than vitriolic earth. To those who know how deficient the ancients were in the knowledge of salts, and of mineralogy in general, this assertion will without further proof appear highly probable. Alum and vitriol are neutral salts, or, to speak more correctly, saline substances, which have a very close affinity. Both contain the same acid called the vitriolic; both have a strong astringent quality, and on this account are often comprehended under the common name of styptic salts. Both are also not only found in the same places, but are frequently obtained from the same minerals; and both can be sometimes employed in the like manner, and for the same purposes. The difference, that vitriol is combined with a metallic earth, either that of iron, copper or zink, and alum on the other hand with a peculiar white earth, called therefore alum-earth, has been established only in modern times.

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* What the Romans called *alumen* was by the Greeks called στυπτηρια.

A stronger proof, however, in favour of my assertion is what follows: The Greeks and the Romans speak of no other than natural alum; but our alum is seldom produced spontaneously in the earth, and several of our most accurate mineralogists, such as Scopoli and Sage,* deny the existence of natural alum. Real alum crystals are formed very rarely, on minerals which abound in a great degree with aluminous particles, when they have been exposed a sufficient time to the open air and the rain;† and even then they are so small and so much scattered, that it requires an experienced and attentive observer to know and discover them. The smallest trace of alum-works is not to be found in the ancients, nor even of works for making vitriol, except what is mentioned by Pliny, who tells us that blue vitriol was made in Spain, by the process of boiling; and this circumstance he considers as the only one of its kind, and so singular, that he is of opinion no other salt could be obtained in the same manner.* Besides, every thing related by the ancients of their alum agrees perfectly with natural vitriolic substances: but to describe them all might be difficult; for they do not speak of pure crystals, but of saline bodies, which nature of itself exhibits in various ways, and under a variety of forms; and every small difference in the colour, the exterior or interior conformation, however accidental, provided it could be clearly distinguished, was to them sufficient to make a distinct species, and to induce them to give it a new name.†

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* Examen chymique de différentes substances minerales, par M. Sage: or my translation *Chemische untersuchung einiger mineralien.* Göttingen 1775. 8vo. p. 148.

† Some crystals of this kind were observed by Linnæus and Morand. See the Travels of the former through Scandinavia, p. 291, and the account of the latter in my *Physical.-ökonom. Bibliothek,* iii. p. 469.

The celebrity which the ancient alum had, as a substance extremely useful in dyeing and medicine, was entirely forgotten when the alum of the moderns became known; but this celebrity was again revived when it was discovered that real alum could be often made from vitriolic minerals; or that where the latter are found there are generally minerals which abound with it. In many of these places alum-works have, in the course of time, been erected: and this circumstance has served in some measure to strengthen the opinion that the alum of the ancients and that of the moderns are the same salt; because where the former was found in ancient times, the latter has since been procured by a chemical process. Some historians of the fifteenth century even speak of the alum-works erected at that period, as if the art of making this salt had only been revived in Europe.

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* Nec ullius æque mira natura est. *Plin.* lib. xxxiv. c. 12. The same account is given by *Isidor. Origin.* lib. xvi. c. 2. and by *Dioscorides*, lib. v. c. 114. The latter, however, differs from Pliny in many circumstances.

† Those who are desirous of seeing every thing that the ancients have left us respecting their alum may consult *Aldrovandi Museum metallicum*, and *Bernardi Cæsii Mineralogia*. Lugduni 1636. fol. p. 334.

The ancients procured their alum from various parts of the world. Herodotus mentions Egyptian alum; for he tells us that, when the people of Delphos, after losing their temple by a fire, were collecting a contribution in order to rebuild it, Amasis king of Egypt sent them a thousand talents of alum.* In Pliny's time the Egyptian alum was accounted the best. It is well known that real alum is reckoned among the exports of Egyyt at present;† but I am acquainted with no author who mentions the place where it is found or made, or who has described the method of preparing it.

The island of Melos, now called Milo, was particularly celebrated on account of its alum, as we learn from Diodorus Siculus, Celsus, Pliny, and others, though none was to be found there in the time of Diodorus.‡ This natural vitriol has been observed in the grottos of that island by several modern travellers, such as Tournefort* and Matthews,† who very properly consider it as the real alum of the ancients.

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* Αμασις, μεν γαρ σφι εδωκε χιλια, στυπτηριης, ταλαντα. Herodot. lib. ii. c. 180. Franc. 1608. fol.

† A catalogue of the Egyptian articles of commerce may be found in *Nouvelle relation d'un voyage fait en Egypte*, par le P. Vansleb, Paris 1677. 12mo. p. 204.

‡ Diodor. Sic. lib. v. ed. Wesselingii, i. p. 338.

The islands of Lipara and Strongyle, or, as they are called at present, Lipari and Stromboli, contained so great a quantity of this substance, that the duty on it brought a considerable revenue to the Romans.‡ At one period, Lipari carried on an exclusive trade in alum, and raised the price of it at pleasure; but in that island, at present, there are neither vitriol- nor alum-works.§ Sardinia, Macedonia, and Spain, where alum was found formerly, produce still a salt known under that name.||

When our alum became known, it was considered as a species of the ancient; and as it was purer, and more proper to be used on most occasions, the

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* Tournefort, Voyage, i. p. 63.

† Matthews's Travels may be found in the German translation of Blainville's. Lemgo 1767. vol. v. p. 445, 446. There is also a French translation of them, intitled *Voyage en France, en Italie, et aux isles de l'Archipel en* 1750, *traduit de l'Anglois*. Paris 1763. four vol. 4to. Some information respecting the same subject may be seen in that expensive but useful work, *Voyage pittoresque de la Grèce*, i. p. 12.

‡ Diodor. Sic. lib. c. Strabo, lib. vi. edit. Almel. p. 423.

§ See Deodat. de Dolomieu, Reise nach den Liparischen Inseln. Leipzig 1783. 8vo. p. 80.

|| Copious information respecting the Spanish alum-works may be found in *Introduccion à la historia natural y à la geografia fisica de Espagna*, par D. Guil. Bowles; preliminary discourse, page 39, and in Travels through Spain, by Dillon, London 1780. 4to. p. 220.

name of alum[*] was soon appropriated in a particular manner to it alone. The kinds of alum however known to the ancients, which were real vitriol, maintained a preference in medicine and for dyeing black; and on this account, these impure substances have been still retained in druggists' shops under the name of *misy*, *sory*, &c. But a method was at length found out of forming them into a lye, and of procuring thence crystallized martial salts, which obtained the new name of *vitriol*. This appellation had its rise first in the eleventh or twelfth century; at least I know no writer older than Albertus Magnus[†] by whom it is mentioned or used. Agricola[‡] conjectures that it was occasioned by the likeness which the crystals of vitriol had to glass. This is also the opinion of Vossius;[*] and it is very singular that Pliny says nearly the same thing; for he observes, speaking of blue vitriol, the only kind then known, that one might almost take it for glass.[†]

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[*] The derivation of the Latin name *alumen*, which, if I mistake not, occurs first in Columella and Pliny, is unknown. Some deduce it from ἁλμη; others from αλειμμα; and Isidore gives a derivation still more improbable. May it not have come from Egypt with the best sort of alum? Had it originated from a Greek word, it would undoubtedly have been formed from στυπτηρια. This appellation is to be found in Herodotus; and nothing is clearer than that it has arisen from the astringent quality peculiar to both the salts, and also from στυφειν, as has been remarked by Dioscorides, Pliny, and Galen. The latter says, Τουτου του Φαρμακου και τ' ουνομα παρωνομασαι τη στυφει, σφοδροτατην, γαρ αυτην εχει. This drug has acquired its name from (τη στυφει) astringency, because it possesses that quality in a high degree. *Galenus de simp. medicam. facultat.* lib. ix. c. 3. 30. See also *G. J. Vossii Etymologicon linguæ Latinæ*, Neapoli 1762. fol. p. 30.

[†] Viride etiam, quod a quibusdam vitreolum vocatur. *Alberti Magni Operu omnia.* Lugduni 1651.

[‡] G. Agricola. lib. iii. de nat. fossilium. Basiliæ 1546. fol. p. 219.

By inquiring into the uses to which the ancients applied their alum, I find that it was sometimes employed to secure wooden buildings against fire. This remark I have here introduced to shew that this idea, which in modern times has given occasion to many expensive experiments, is not new. Aulus Gellius[‡] relates, from the works of an historian now lost, that Archelaus, one of the generals of Mithridates, washed over a wooden tower with a solution of alum, and by these means rendered it so much proof against fire, that all Sylla's attempts to set it in flames proved abortive. Many have conjectured that the substance used for this purpose was neither vitriol nor our alum, but rather asbestos, which is often confounded with Atlas-vitriol;* and against this mistake cautions are to be found even in Theophrastus. But it may be asked, With what was the asbestos laid on? By what means were the threads, which are not soluble in water, made fast to the wood? How could a tower be covered with it? I am rather inclined to believe, that a strongly saturated vitriol-lye might have, in some measure, served to prevent the effects of the fire, at least as long as a thin coat of potters-earth or flour-paste, which, in the present age, have been thought deserving of experiments attended with considerable expense. It does not however appear that the invention of Archelaus, which is still retained in some old books,† has been often put in practice;‡

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[*] Atramentum sutorium variis coloribus præditum est; - - - - candidum potissimum stiriæ figura reperitur Goslariæ, translucidum crystalli instar; nec cæruleum nec viride caret perspicuitate; unde superior ætas atramento sutorio vitrioli nomen imposuit. *Vossii Etymol.* p. 779.

[†] Color et cæruleus, perquam spectabili nitore, vitrumque creditur. *Plin.* lib. xxxiv. c. 12.

[‡] Verba Quadrigarii hæc sunt: Tum Sulla conatus est, et tempore magno eduxit copias, ut Archelai turrim unam, quam ille interposuit, ligneam incenderet. Venit, accessit, ligna subdidit, submovit Græcos, ignem admovit; satis sunt diu conati, nunquam quiverunt incendere; ita Archelaus omnem materiam obleverat alumine. Quod Sulla atque milites mirabantur; et, postquam non succendit, reduxit copias. *A. Gellii Noct. Att.* lib. xv. c. 1.

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* The *halotrichum* of Scopoli. See *Scopoli Tentamen de hydrargyro Idriensi*, and his *Principia mineralogiæ*, p. 81. See also my observations on *Sages Chemische untersuchung einiger mineralien*, p. 149. *Chartheuser, Elementa mineral.* p. 43; and *Wallerii System. Miner.* ii. p. 32. The first person who discovered this salt to be vitriolic was Henkel, as we find in his *Kiesshistorie*, p. 856, where he calls it *Atlas-vitriol.*

† Wecker de Secretis, lib. ix. 18. p. 445.

‡ I can give only one instance of its being used for this purpose, taken from Ammianus Marcellinus: Persæ aggerum altitudine jam in sublime porrecta, machinæque ingentis horrore perculsi, quam minores quoque sequebantur, omnes exurere vi maxima nitebantur; et assidue malleolos atque incendiaria tela torquentes laborabant incassum; ea re quod humectis scortis et centonibus erant opertæ materiæ plures, aliæ unctæ alumine diligenter, ut ignis per eas laberetur innoxius. *Ammian. Marcel.* lib. xx. c. 12.

for writers on the art of war, such, for example, as Æneas,* recommended vinegar to be washed over wood, in order to prevent its being destroyed by fire.

I shall now proceed to the history of our present alum, which was undoubtedly first made in the East. The period of the invention I cannot exactly determine, but I conclude, with certainty, that it is later than the twelfth century; for John, the son of Serapion, who lived after Rhazes, was acquainted with no other alum than the impure vitriol of Dioscorides.† What made the new alum first and principally known, was its beneficial use in the art of dyeing, in which it is employed for fixing as well as rendering brighter and more beautiful different colours. This art, therefore, the Europeans learned from the Orientals, who, even yet, though we have begun to apply chemistry to the improvement of dyeing, are in some respects superior to us, as is proved by the red of Adrianople, their silks, and their Turkey-leather. The Italians procured their first alum from the Levant, along with other materials for dyeing; but when these countries were taken possession of by the Turks, it grieved the Christians to be obliged to purchase these necessary articles from the common enemy, and bitter complaints on that subject may be seen in the works of various authors. In the course of time, the Italians became acquainted with the art of boiling alum; for some of them had rented Turkish alum-works, and manufactured that salt on their own account. They, at length, found aluminous minerals in their own country, on which they made experiments. These having answered their expectations, they were soon brought into use; and this branch of trade declined afterwards so much in Turkey, that many of the alum-works there were abandoned.

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* Majus juverit, si prius ligna aceto linantur; nam a materia aceto illita ignis abstinet. *Æneæ Poliorcet.* cap. 34.

† Johannis Serapionis Arabis de simplicibus medicinis opus; edit. Othonis Brunsfelsii, Argentorati 1531. fol. cap. 410. p. 276.

We are told by many historians, that the Europeans who first made alum in Italy learned their art, as Augustin Justinian says, at *Rocca di Soria*, or Rocca in Syria. Neither in books of geography nor in maps, however, can I find any place of this name in Syria. I at first conjectured that Rocca on the Euphrates might be here meant;* but at present it appears to me more probable that it is Edessa, which is sometimes called Roha, Raha, Ruha, Orfa, and also Roccha, as has been expressly remarked by Niebuhr.† Edessa is indeed reckoned to be in Mesopotamia; but some centuries ago Syria, perhaps, was understood in a more extended sense. This much, at least, is certain, that minerals which indicate alum, such for example as bitumen, have been often observed by travellers in that neighbourhood.[*]

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* Büschings Geograph. v. p. 214. Beschreibung der Reyss Leonhardi Rauwolffen. Frank. 1582. 4to. ii. p. 36. Naukeurige beschryving van Asie—door Dapper. Amsterdam 1680. fol. p. 23.

† Reisebeschreibung, ii. p. 408, 409. Dapper, p. 26. Büsching, p. 212. *See also* Michaelis Orientalische Bibliothek, xiii. p. 46.

It appears that the new alum was at first distinguished from the ancient vitriol by the denomination of *Rocca*, from which the French have made *alun de roche*, and some of the Germans *rotzalaun*.[†] Respecting the origin of this name very different conjectures have been formed. Some think it is derived from *rocca*, which in the Greek signifies a rock, because this salt is by boiling procured from a stone; and these translate the word *alumen rupeum*, from which the French name is formed.[‡] Some are of opinion, that alum boiled from stones has been so called to distinguish it from that procured from sand, which is generally combined more with iron than the former;[§] and others maintain that alum acquired the name of

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[*] Büsching, p. 200.

[†] This singular appellation occurs in *Valentini Historia simplicium*; in Martini's Dictionary of natural history; and several other works.

[‡] Vulgo audis *alumen rochæ*, quæ Græca vox maximæ Europæ servit parti ad rupem significandam. *Jul. Cæs. Scaligeri Exot. exercitat.* Francof. 1612. 8vo. p. 325.

[§] This is the opinion of Mazeas; a translation of whose treatise I caused to be inserted in the *Naturforscher*, ii. p. 217. I shall here take occasion to remark, that sand seems to have been employed for making alum in the time of Agricola, as appears by his book *De ortu et causis subterraneorum*, p. 47.

Rocca from the alum-rocks in the neighbourhood of Tolfa.* It is to be remarked, on the other hand, that Biringoccio, that expert Italian, confesses he does not know whence the name has arisen.† For my part, I am inclined to adopt the opinion of Leibnitz, that *alumen roccæ* was that kind first procured from Rocca in Syria; and that this name was afterwards given to every good species of alum, as we at present call the purest *Roman alum.*‡

In the fifteenth century, there were alum-works in the neighbourhood of Constantinople, from which John di Castro, of whom I shall have occasion to speak hereafter, learned his art. May not these alum-works be those visited by Bellon, and of which he has given an excellent description? § He names the place *Cypsella* or *Chypsilar*, and says, that the alum in commerce is called *alumen Lesbium*, or *di Metelin.* ‖ The alum procured from Constantinople at present, may perhaps be brought from the same spot; but I am not sufficiently acquainted with its situation to determine that point with certainty, for Büsching makes no mention of it. In some maps I find the names *Ypsala* and *Chipsilar* on the western side of the river Mariza, Maritz or Maricheh, which was the Hebrus of the ancients;[*] in others stands the name *Scapsiler* on the west bank of the sea Bouron;[†] and it is not improbable that these may be all derived from the old *Scaptesyle* or *Scapta Hyla*, where, according to the account of Theophrastus, Pliny, and others, there were considerable mines.[‡]

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* Mercati is of this opinion, in his Metallotheca, p. 54.

† Pyrotechnia. In Venegia 1559. 4to. lib. ii. cap. 6.

‡ Cum constet, ejus coquendi artem vix trecentis abhinc annis a Rocca Syriæ in Europam rediisse (unde *aluminis Roccæ* non intellecta vulgo appellatio), atque in Italia primum exercitam, serius in Germaniam penetrasse. *Leibnitii Protogæa,* p. 47.

§ Bellonii Observationes, *at the end of* Clusii Exotica, cap. lxi. p. 64.

‖ The latter name occurs in Biringoccio, Pyrotechnia, p. 31.

Another alum-work, no less celebrated in the fifteenth century, was established near the city *Phocæa Nova*, at present called *Foya Nova*, not far from the mouth of the Hermus, in the neighbourhood of Smyrna.[§] Of this work, Ducas, who had a house there, has given a particular description, from which we learn that in his time, that is under the reign of Michael Palæologus, it was farmed by Italians, who sold the produce of it to their countrymen, and to the Dutch, French, Spaniards, English, Arabs, Egyptians, and people of Syria.

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[*] Carte de la Grèce, dressée sur les mémoires de MM. Wheeler, Tournefort—par G. de l'Isle. A Amsterdam, chez Ottens. In this map we find expressly noticed: *Ypsala, Chapsilar, alum-mines.* The same situation is given to *Ipsela, Cypsela* in the map of Thrace and Greece, in Pocock's Travels.

[†] In Lotter's map of *Græcia nova.*

[‡] Cellarii Geographia, i. p. 1299. In the map, however, published a few years ago at Berlin, under the title of *Græcia antiqua delineata a* I. C. R. A. G. *Scapta Hyla* is placed on the west side, and *Cypsela* on the east.

[§] Büsching's Geograph. v. p. 74.

This author relates very minutely, in what manner the alum was made,* but that work has been long since abandoned: † alum however made in the neighbourhood is still exported from Smyrna.‡ It is much to be wished, that ingenious travellers would examine the alum-works in Thrace, around Smyrna, and in Turkey in general, and give an accurate description of them according to the state in which they are at present.*

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* In Phocis, which lies close to Ionia, there is a mountain abundant in aluminous mineral (ορος ην εν ὡ μεταλλον στυπτηριας ὑπαρχει). The stones found on the top of this mountain are first calcined in the fire, and then reduced to sand by being thrown into water. The water mixed with that sand is put into a kettle; and a little more water being added to it, and the whole having been made to boil, the sand is liquefied, and the thick part which falls to the bottom in a cake is preserved; what is hard and earthy is thrown away as of no use. The cake is afterwards suffered to dissolve in vessels for four days; at the end of which the alum is found in crystals around their edges, and the bottoms of them also are covered with pieces and fragments of the like nature. The remaining liquor, which at the end of four days does not coagulate or harden, is poured into a kettle, more water and more sand is added to it; and being boiled as before, it is put into proper vessels, and the alum obtained in this manner is preserved as an article very necessary for dyers. All masters of ships, bound from the Levant to Europe, consider alum as a very convenient and useful lading for vessels. - - - - In the reign of Michael Palæologus, the first emperor of his family, some Italians requested a lease of that mountain, for which they promised to pay a certain sum annually. - - - - The Romans and the Latins built *Phocæa Nova* on the sea-shore, at the bottom of that mountain which lies on the east side of it. On the west it has the island of Lesbos, on the north the neighbouring bay of Elæa, and on the south it looks towards the Ionian sea. *Ducæ, Michaelis Ducæ nepotis, Historia Byzantina, res imperio Græcorum gestas complectens a Joanne Palæologo I. ad Mehemetem II.*——studio et opera Ismaëlis Bullialdi. Venetiis 1729. p. 71.

† Bouillaud in his observations on Ducas, p. 186.

‡ Observations sur le commerce et sur les arts, par Flachat. Lyon 1766. ii. p. 431. The alum of Smyrna is mentioned by Baumé in his Experimental Chemistry, i. p. 458.

The oldest alum-works in Europe were established about the middle of the fifteenth century, but where they were first erected cannot with certainty be ascertained; for it appears that several were set on foot in different places at the same period. Some affirm that the first alum made in Europe was manufactured in the island Ænaria, or Pithacusa, at present called Ischia, by a Genoese merchant, whom some name Bartholomew Perdix, and others Pernix. This man, who is praised on account of his ingenuity, and attachment to the study of natural history, having often travelled through Syria, learned the method of boiling alum at Rocca; and on his return found alum-stones among the substances thrown up by the eruption of a volcano which had destroyed part of the island, and gave occasion to their being first employed in making that salt. Such is the account of respectable historians, Pontanus,* Bizaro,† Augustine Justinian,* and Bottone,† who wrote much later. Bizaro says, that this happened in the year 1459, which agrees perfectly with the account of Pontanus; for he tells us that it was under the reign of Ferdinand I, natural son of Alphonsus, who mounted the throne in 1458. Besides, the earthquake, which had laid waste the island one hundred and sixty-three years before, took place in 1301, which

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* Professor Sprengel was so kind as to point out to me where an account might be found of other Eastern alum-works. This information is contained in a treatise of Francesco Balducci Pegolotti, written in the middle of the fourteenth century, on the state of commerce at that time, and printed in a book intitled *Della decima e di varie altre gravezze imposte dal commune di Firenze.* Lisbona e Lucca 1765. 4to. 4 vol. Of Pegolotti some account may be seen in vol. ii. p. 61 and 74; and what he says of the kinds of alum then in use is in vol. iii. p. 368. I must acknowledge that I do not understand this old Italian author; and the learned marquis Hippolito Durazzo of Genoa, author of the well-written *Elogio di Christophoro Colombo,* when I had the pleasure of seeing him lately, confessed that some parts were unintelligible even to him. It appears, however, from this work, that in the fourteenth century the Italians were acquainted with no other than Turkish alum.

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* I shall embrace this opportunity of giving a brief account of the situation of the island, and of the nature of its soil. That Ænaria has been at some time violently separated from the continent by an earthquake, seems proved by a variety of circumstances, such as calcined rocks; the ground full of caverns; and the earth, which, like that of the main land, being abundant in warm springs, and dry, feeds internal fire, and on that account contains a great deal of alum. A few years ago Bartholomew Perdix, a Genoese merchant, passing this island, in his way to Naples, observed some aluminous rocks scattered here and there along the sea-coast. About a hundred and sixty-three years before that period, the earth having suddenly burst by the effects of fire confined in its bowels, a considerable part of Ænaria was involved in flames. By this eruption a small town was burned and afterwards swallowed up; and large masses of rock mixed with flames, sand, and smoke, thrown up, where the shore looks towards Cumæ, fell upon the neighbouring fields, and destroyed the most fruitful and the most pleasant part of the island. Some of these huge pieces of rock being at that time still lying on the shore, Bartholomew, by calcining them in a furnace, extracted alum from them, and revived that art which he had brought from Rocca in Syria, where he had traded for several years, and which had been neglected in Italy for many centuries. *Joannis Joviani Pontani Historiæ Neapolitanæ libri sex*, in *Grævii Thesaurus antiquit. et historiarum Italiæ*, vol. ix. part 3. p. 88.

† I must not omit to mention that about this time Bartholomew Pernix, a citizen and merchant of Genoa, who had resided long in Syria for the purpose of commerce, returned to his native country. Soon after he made a voyage to the island of Ænaria, situated in the

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Tuscan sea, called formerly Pythacusa, and now in the vulgar Greek Iscla or Ischia; and being a man of an acute genius, and a diligent investigator of natural objects, he observed near the sea-coast several rocks fit for making alum. He took some fragments of them therefore, and, having calcined them in a furnace, he procured from them most excellent alum. He was the first person who, to the incredible benefit of many, brought as it were again into use that art long abandoned and almost lost in Italy and the greater part of other countries. On that account his name deserves to be rescued from oblivion. *Senatus populique Genuensis rerum hist. atque annal. auctore Petro Bizaro Sentinati.* Antverpiæ 1579. fol. p. 302.

* About that period (1459) Bartholomew Pernix, a Genoese merchant, sailing past the island of Ænaria or Ischia, learned that there were near the shore many aluminous rocks, that is to say, fit for making alum. He took some of them, therefore, and having caused them to be calcined in a furnace, he procured from them most excellent alum. This Bartholomew brought back to Italy from the city of Rocca, in Syria, where he had traded many years, the art of making alum, which had been neglected and lost for a long space of time. *Castigatissimi annali, con la loro copiosa tavola, della republica di Genoa, da fideli e approvati scrittori, per Monsignore Agostino Giustiniano, Genoese, Vescovo di Nebio.* Genoa 1537. fol. lib. v. p. 214.

† Dominici Bottone, Pyrologia topographica; id est, de igne dissertatio. Neapoli 1692. 4to. p. 313. This author calls the inventor *Perdix*, and not *Pernix*.

makes the time of this invention to fall about the year 1464. So seems Bottone also to have reckoned, for he mentions expressly the year 1465.

The alum-work which is situated about an Italian mile north-west from Tolfa, and six from Civita Vecchia, in the territories of the Church, is by some Italian historians reckoned to have been the first. However this may be, it is certain that it is the oldest carried on at present. The founder of it was John di Castro, a son of the celebrated lawyer, Paul di Castro,* who had an opportunity at Constantinople, where he traded in Italian cloths, and sold dye-stuffs, of making himself acquainted with the method of boiling alum. He was there at the time when the city fell into the hands of the Turks; and after this unfortunate event, by which he lost all his property, he returned to his own country. Pursuing there his researches in natural history, he found in the neighbourhood of Tolfa a plant which he had observed growing in great abundance in the aluminous districts of Asia: from this he conjectured, that the earth of his native soil might also contain the same salt; and he was confirmed in that opinion by its astringent taste. At this time he held an important office in the Apostolic Chamber; and this discovery, which seemed to promise the greatest advantages, was considered as a real victory gained over the Turks, from whom the Italians had hitherto been obliged to purchase all their alum. Pope Pius II, who was too good a financier to neglect such a beneficial discovery, caused experiments to be first made at Viterbo, by some Genoese who had formerly been employed in the alum-works in the Levant, and the success of them was equal to his expectations. The alum, which was afterwards manufactured in large quantities, was sold to the Venetians, the Florentines, and the Genoese. The Pope himself has left us a very minute history of this discovery, and of the circumstances which gave rise to it.*

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* The most authentic account of Paul di Castro is to be found in *Fabricii Biblioth. lat. mediæ et infimæ ætatis*, vol. v. p. 617, and in *Joh. Fichardi Vitæ Ictorum*, which is printed along with *Pancirolli Libri de claris legum interpretibus*. Lipsiæ 1721. 4to. p. 186. Paul di Castro was not of Castro in the kingdom of Naples, as is said in Jocher's *Gelehrten Lexicon*, but of Castro belonging to the duchy of the same name in the Ecclesiastical States.

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* A little before that period came to Rome John di Castro, with whom the Pontiff had been acquainted when he carried on trade at Basle, and was banker to Pope Eugenius. His father, Paul, was a celebrated lawyer of his time, who sat many years in the chair at Padua, and filled all Italy with his decisions; for law-suits were frequently referred to him, and judges paid great respect to his authority, as he was a man of integrity and sound learning. At his death he left considerable riches, and two sons arrived to the age of manhood, the elder of whom, following the profession of the father, acquired a very extensive knowledge of law. The other, who was a man of genius, and who applied more to study, made himself acquainted with grammar and history; but, being fond of travelling, he resided some time at Constantinople, and acquired much wealth by dyeing cloth made in Italy, which was transported thither, and committed to his care, on account of the abundance of alum in that

Some pretend that Castro was several years a slave to a Turk who traded in alum;* others affirm,

neighbourhood. Having by these means an opportunity of seeing daily the manner in which alum was made, and from what stones or earth it was extracted, he soon learned the art. When, by the will of God, that city was taken and plundered about the year 1453, by Mahomet II, emperor of the Turks, he lost his whole property; but, happy to have escaped the fire and sword of these cruel people, he that he had even been obliged to labour as a slave in alum-works;* and others, that he learned the

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* The Frangipani a third time acquired lands in the kingdom of Naples. When they possessed in Maremma di Roma, Tolfa, Castello, and a jurisdiction which brings at present eighty thousand crowns annually to the Church, it happened that a son of Paul di Castro, a celebrated doctor, and a vassal of these lords, who had been many years a slave in Turkey to an alum-merchant, returned free to his own country; and observing that in the territories of Tolfa there was abundance of alum mineral, he gave notice of it to Lodovico Frangipani, his lord, and was the cause of greatly increasing his revenues. Pope Paul II, however, pretending that the mineral belonged to the Apostolic See, as supreme lord of the fief; and not being able to persuade Lodovico to give it up to the Church, he declared war against him, but was vigorously opposed by Lodovico and his brother Peter, lords of Tolfa, assisted by the Orsini their relations, so that the Pope was obliged to bring about an accommodation with them by means of king Ferrante I, and to pay them as the price of Tolfa sixteen thousand crowns of gold, of which Lodovico gave twelve thousand to the king, and was invested by him in the lordship of Serino in the year 1469.——*Discorsi delle famiglie estinte, forestiere, o non comprese ne' Seggi di Napoli, imparentate colla casa della Marra. Composti dall Signor Don Ferrante della Marra, duca della Guardia; dati in luce da Don Camillo Tutini Napolitano.* In Napoli 1641. fol. p. 178.

See also Istoria dell' antichissima città de Civita Vecchia, scritta dal Marchese Antigono Frangipani. In Roma 1761. 4to. p. 119, 120, 121. 128. Platina, in his Life of Pope Pius II, says nothing further of this remarkable circumstance than: Fodinas invenit (Pius II), tum primum aluminis apud Tolfam instituit.

he returned to Italy, after the assumption of Pius II, to whom he was related, and from whom he obtained, as an indemnification for his losses, the office of commissary-general over all the revenues of the Apostolic Chamber, both within and without the city. While, in this situation, he was traversing all the hills and mountains, searching the bowels of the earth, leaving no stone or clod unexplored, he at length found some alum-stone in the neighbourhood of Tolfa. Old Tolfa is a town belonging to two brothers, subjects of the Church of Rome, and situated at a small distance from Civita Vecchia. Here there are high mountains, retiring inland from the sea, which abound with wood and water. While Castro was examining these, he observed that the grass had a new appearance. Being struck with wonder, and inquiring into the cause, he found that the mountains of Asia, which enrich the Turkish treasury by their alum, were covered with grass of the like kind. Perceiving several white stones, which seemed to be minerals, he bit some of them, and found that they had a saltish taste. This induced him to make some experiments by calcining them, and he at length obtained alum. He repaired, therefore, to the Pontiff, and addressing him said, "I announce to you a victory over the Turk. He draws yearly "from the Christians above three hundred thousand pieces of gold, "paid to him for the alum with which we dye wool different colours, because none is found here but a little at the island of Hiscla, "formerly called Ænaria, near Puteoli, and in the cave of Vulcan "at Lipari, which, being formerly exhausted by the Romans, is "now almost destitute of that substance. I have, however, found "seven hills, so abundant in it, that they would be almost sufficient "to supply seven worlds. If you will send for workmen, and cause "furnaces to be constructed, and the stones to be calcined, you may "furnish alum to all Europe; and that gain which the Turk used "to acquire by this article, being thrown into your hands, will be "to him a double loss. Wood and water are both plenty, and you "have in the neighbourhood the port of Civita Vecchia, where vessels art of boiling alum from a citizen of Corneto, a town in the dominions of the Pope, and from a

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* Ferbers Briefe über Welschland, p. 246.

"vessels bound to the West may be loaded. You can now make "war against the Turk: this mineral will supply you with the "sinews of war, that is money, and, at the same time, deprive the "Turk of them." These words of Castro appeared to the Pontiff the ravings of a madman: he considered them as mere dreams, like the predictions of astrologers; and all the cardinals were of the same opinion. Castro, however, though his proposals were often rejected, did not abandon his project, but applied to his Holiness by various persons, in order that experiments might be made in his presence, on the stones which he had discovered. The Pontiff employed skilful people, who proved that they really contained alum; but lest some deception might have been practised, others were sent to the place where they had been found, who met with abundance of the like kind. Artists who had been employed in the Turkish mines in Asia were brought from Genoa; and these, having closely examined the nature of the place, declared it to be similar to that of the Asiatic mountains which produce alum; and, shedding tears for joy, they kneeled down three times, worshipping God, and praising his kindness in conferring so valuable a gift on our age. The stones were calcined, and produced alum more beautiful than that of Asia, and superior in quality. Some of it was sent to Venice and to Florence, and, being tried, was found to answer beyond expectation. The Genoese first purchased a quantity of it, to the amount of twenty thousand pieces of gold; and Cosmo of Medici for this article laid out afterwards seventy-five thousand. On account of this service, Pius thought Castro worthy of the highest honours, and of a statue, which was erected to him in his own country, with this inscription: "To John di Castro, the inventor of alum;" and he received besides a certain share of the profit. Immunities and a share also of the gain were granted to the two brothers, lords of Tolfa, in whose land the aluminous mineral had been found. This accession of wealth to the Church of Rome was made, by the divine blessing, under the pontificate of Pius II; and if it escape, as it ought, the hands of tyrants, and be prudently managed, it may increase, and afford no small assistance to the Roman Pontiffs in supporting the burdens of the Christian religion.——*Pii Secundi Comment. rer.*

Genoese, both of whom had acquired their knowledge in the Levant.* But as I do not wish to ascribe a falsehood to the Pontiff, I am of opinion that the history of this discovery must have been best known to him. He has not, indeed, established the year with sufficient correctness; but we may conclude from his relation that it must have been 1460 or 1465. The former is the year given by Felician Bussi; and the latter that given in the history of the city of Civita Vecchia.

The plant which first induced John di Castro to search for alum was that ever-green, prickly shrub, the *ilex aquifolium*, or holly, which in Italy is still

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memorab. quæ temp. suis contigerunt, Joan. Gobellino compositi, a Franc. Bandino Picolomineo ex vetusto origin. recog.; quibus hac edit. accedunt Jac. Picolominei Rer. gest. sui temp. commentarii. Francofurti 1614. fol. p. 185.

* This year (1460) is distinguished by the discovery of alum at Tolfa Vecchia, no one there having been acquainted with it till that period: and this happened by means of one John di Castro, who had acquired some knowledge of it from a young man of Corneto, and a Genoese, who had learned in Turkey the whole process of making it. The said John having observed that in the mountains of Tolfa there were undoubtedly veins of alum, he caused some of the earth and stones to be dug up, and the first experiments were made on them at Viterbo in the following manner. The stones were first calcined in a furnace; a large quantity of water was then thrown over them; and when they were entirely dissolved, the water was boiled in great leaden cauldrons; after which it was poured into wooden vessels; where evaporating by degrees, the result was alum of the most perfect kind. Pope Pius II, sensible of the great benefit which might arise from this mineral to the Apostolic Chamber, employed more than eight hundred persons at Tolfa in preparing it.——*Historia della città de Viterbo, di Feliciano Bussi.* In Roma 1742. fol. p. 262.

considered as an indication that the regions where it grows abound with that salt.* But though it is undoubtedly certain that the quality of the soil may be often discovered by the wild plants which it produces, it is also true that this shrub is frequently found where there is not the smallest trace of alum; and that it is not to be seen where the soil abounds with it, as has been already remarked by Boccone † and Tozzetti. ‡

Among the earliest alum-works may be reckoned that which was erected at Volterra, in the district of Pisa, in 1458, by a Genoese named Antonius. § Others say that it was constructed by an architect of Sienna; ‖ but this opinion has, perhaps, arisen only from the work having been farmed by a citizen of Sienna, or built at his expense. On account of this alum-work an insurrection of the inhabitants of Volterra broke out in 1472; but it was at length quelled by the Florentines, who took and plundered the city.* Brutus,† who wrote his History of Florence in the year 1572, says that this alum-work was carried on in his time: but this is certainly false; for Raphael di Volterra,‡ who died in 1521 in his native city, expressly tells us, that, in his time, alum was no longer boiled there; and this is confirmed by Baccius,§ who also lived in the sixteenth century. At present, no remains of it are left; so that Tozzetti was not able to discover the place where the alum-stones were broken.‖

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* Labat Reisen nach Welschland. Frankf. and Leipzig. vol. v. 1760. 8vo. p. 3 et seq.

† Museo di fisica e di esperienze, di Don Paolo Boccone. In Venetia 1697. p. 152.

‡ Targioni Tozzetti, Viaggi, vii. p. 234.

§ Anno 1458. Rock alum, which the Greeks call *pharno*, was at this time first discovered by a Genoese in the territories of Volterra, where being boiled and found to be good, it began to be dug up afterwards in many of the mountains of Italy. Till that period the Italians had made no use of mines of this kind; for our alum was all brought from Turkey. The above discovery was, therefore, a great advantage to us.——*Supplementum supplementi chronicorum; edit. et cast. a patre Jacobo Philippo Bergomare.* Venetiis 1513. fol. p. 299.

‖ Antonius quidam Senensis architectus, haud longe ab ea urbe (Berignone, jam diu deleta), ad eum prospectum qui vergit ad Cecinæ fluvium, aluminis tolpham (*probably* mineram) comperuit, in publico usu atque in vectigalium censu neutiquam spernendam.—— *Giovanni Giovanniense, Monarchia Medicea,* p. 51. 58.

It appears from what has been said, that the art of boiling alum in Europe was first known in Italy, but not before the year 1458. That document, therefore, of the year 1284, quoted by Tozzetti, and in which alum-works, *alumifodinæ*, are mentioned, must, as he himself thinks, be undoubtedly false.*

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* An account of this dispute between the Florentines and the people of Volterra may be seen in Machiavel's History of Florence, book vii.—TRANS.

† Jo. Michaël. Bruti Historia Florentina. Venetiis 1764. 4to. lib. v. p. 244.

‡ Nunc foditur alumen nuper inventum pluribus in locis in Hetruria, apud Forum Claudii, præterea in agro Mussano et Volaterrano; sed Volaterranum jam desiit.—*Raphaelis Volaterrani Comment. urbani*. Francof. 1603. fol. p. 1020.

§ De Thermis.

‖ Relazioni d'alcuni viaggi fatti in diverse parti della Toscana. In Firenze, tom. iii. p. 117.

The great revenue which the Apostolical Chamber derived from alum, induced many to search for aluminous minerals, and works were erected wherever they were found. Several manufactories of this substance were established, therefore, in various parts, which are mentioned by Baccius,† Biringoccio, and other writers of the sixteenth century. The Pope, however, understood his own interest so well, that he never rested until he had caused all the works erected in the territories of others to be given up, and until he alone remained master of the prize. He then endeavoured, by every method possible, to prevent foreigners from acquiring an accurate knowledge of the art of boiling alum; and at the same time found means, by entering into commercial treaties with other nations, and by employing the medium of religion, which has always the greatest effect on weak minds, to extend his commerce in this article more and more. The price was raised from time to time, and it at length became so high that foreigners could purchase this salt at a cheaper rate from the Spaniards, and even when they sent for it to Turkey. His Holiness, that he might convert this freedom of trade into a sin, and prevent it by the terror of excommunication, artfully gave out that he meant to set apart the income arising from his alum-works to the defence of Christianity; that is, towards carrying on war against the Turks. Prohibitions and threats now followed in case any one should be so unchristian as to purchase alum from the Infidels; but every person was at liberty to make what bargain he could with his Holiness for this commodity.

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* The words of the document are: Vendo montem rotundum cum balneis—et cum aurifodinis, argentifodinis, erifodinis, cretifodinis, sufodinis, et alumifodinis et aluminibus ceteribus (*perhaps* veteribus). *Tozzetti, Viaggi*, vii. p. 51.

† Andreas Baccius de thermis. Venetiis 1588. fol. p. 293. Tozzetti, iv. p. 186.

In the year 1468, Pope Paul II entered into a commercial treaty respecting alum with Charles the Bold, duke of Burgundy; but, in 1504, Roman alum had risen to such an exorbitant price, that Philip the Fair, archduke of Austria, caused a council of inquiry to be held at Bruges, by which it appeared that this article could be purchased at a much cheaper rate in Turkey. Commissions, therefore, were sent thither for that purpose;* but scarcely was this known at Rome, when a prohibition, under pain of excommunication, was issued by Pope Julius II. This pontiff, however, was not the only one from whom such prohibitions proceeded: bulls of the like kind were issued also by Julius III, Paul III, Paul IV, Gregory XIII, and others.*

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* Les anciens minéralogistes, par Gobet, vol. ii. p. 805.

But these means, like all those founded on the simplicity of others, could not be of long duration; and as soon as men became a little more enlightened, they learned to know their own interest, and to discover the selfishness of the Pope's bulls. Unless Biringoccio, who visited a part of the German mines, be under a mistake, the first European alum-work without Italy was erected in Spain; and is that still carried on, with considerable profit, at Almacaron, not far from Carthagena.* In the beginning of the sixteenth century very large quantities of alum were brought to Antwerp, as we learn from Guicciardini's Description of the Netherlands.

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* Cum Pontifex Pius II hujusmodi inventi aluminis in Tuscia redditus et proventus in fidei defensionem dedicasset et consecrasset, meritoque Julius II vetuerit alumina ex Infidelium terris adduci, et Christianos ea mercari, ut ita solum venderetur et emeretur inter Christianos quod in terris Romanæ Ecclesiæ insperato fuerat adinventum, ut constat ex Leon. X *bulla* 36 et Pauli III. n. 48; ideo Julius III, imitatus dictum Julium II, qui primus hoc prohibuit sub excommunicatione, et Paul. III, qui eam renovavit, *in alia sua constit.* 42. in *Bullario veteri* edita anno 1553, quæ incipit: *Etsi ea*; cujus contextum adducit Scortia in *Constit. pontif.* epist. 66. theor. 173, ubi explicat ipse Julius III. renovat atque confirmat, contra facientes et complices vectores, ementes, vendentes, laborantes, sese in his immiscentes, naves et alumina assecurantes, Julii II et Pauli III excommunicationem; et, aggravando pœnas, eosdem reddit intestabiles et incapaces hæreditatum, officiorum publicorum; eisque omnes actus legitimos interdicit, et oppida ac civitates, ad quas declinaverint, nisi inde eos expellant intra diem unum post habitam de his notitiam, supponit interdicto ecclesiastico, ut Leo X *bulla* 12, et alii in rebus gravibus fecerant; et reservat tam absolutionem illius quam relaxationem hujus excommunicationis Pontifici Romano; et hanc eandem constitutionem confirmasse postea Paulum IV in *bulla* 43, quæ incipit: *Ex Apostolica*, et Greg. XIII, *num.* 21, quæ incipit: *Muneris*, quarum bullarum ratio ex *textu nostro* colligitur *in vers.* ibi: *Dummodo in mercibus suis* (vel alio modo) *aliquod commodum vel subsidium proveniret*; ut revera contingeret si Christiani emerent alumen a Turcis, pro illo pecunias argenteas et aureas darent, quibus ditiores et potentiores fierent ad Christianos debellandos, et ex verbis *d. c. olim.* 12 hic. *Nicol. Rodrig. Fermosini Tractatus criminalium.* Lugd. 1670. 2 vol. fol. tom. ii. p. 63.

At what time the first alum-work was erected in Germany, I am not able to determine; but it appears that alum began to be made at Oberkaufungen, in Hesse,† in the year 1554. For the alum-work at Commotau in Bohemia,‡ the first letters-patent were granted in 1558. An alum-work was established at Lower Langenau, in the county of Glatz, in 1563; but it was soon after abandoned.§ Several more manufactories of alum are mentioned by Agricola, such as that of Dieben or Duben, in the circle of Leipsic, and those of Dippoldiswalda, Lobenstein, &c.‖

In England, the first alum-work was erected at Gisborough in Yorkshire, in the reign of queen

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* Pyrotechn. p. 31. He says expressly, that this was the only alum-work in Europe in his time without the boundaries of Italy.

† Winkelmans Beschreibung von Hessen, i. p. 39.

‡ Peithners Versuch über die geschichte der Böhmischen und Mährischen bergwerke. Wien 1780. fol. p. 58.

§ Büschings Geographie, iv. p. 843.

‖ De natura fossilium, lib. xii.

Elizabeth; though Anderson* says in 1608. Sir Thomas Chaloner, who had an estate there, conjecturing from the nature of the plants which grew wild, that there must be minerals in the neighbourhood, after making some search, at length discovered alum. As there was, however, no one in England at that time who understood the method of preparing it, he privately engaged workmen belonging to the Pope's alum-works; and it is said, that as soon as the Pontiff heard this, he endeavoured to recall them by threats and anathemas. These, however, did no injury to the heretics; and in a little time the alum-work succeeded so well, that several more of the same kind were soon after established.† But what more dishonoured the Pontiff's denunciations was, that, in later times, the proprietors of the English alum-works farmed those of the Apostolic Chamber, and increased, in various ways, the benefit derived from them.*

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* History of Commerce, iv. p. 406. "The manufacture of alum," says he, "was first found out in England, and carried on with success in 1608. It was supported and patronized in the county of York by lord Sheffield, sir John Bourcher, and other landholders of the said county, to the great benefit of England in general, and of the proprietors in particular, to the present day. King James was a great promoter of this alum-work, after he had, by the advice of his minister, appropriated to himself a monopoly of it, and forbidden the importation of foreign alum.

† Such is the account of Pennant, in his *Tour in Scotland*, 1768, third edition, Warrington 1774, 4to, p. 23. "The alum-works in this country are of some antiquity; they were first discovered by *sir Thomas Chaloner*, in the reign of queen Elizabeth, who observing the trees tinged with an unusual colour, made him suspicious of its being owing to some mineral in the neighbourhood. He found out that the strata abounded with an aluminous salt. At that time the English being strangers to the method of managing it, there is a tradition that sir Thomas was obliged to seduce some workmen from the Pope's

At what period alum-works were established in other countries I have not been able to learn. I however know that one was erected at Andrarum†

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alum-works near Rome, then the greatest in Europe. If one may judge from the curse which his Holiness thundered out against sir Thomas and his fugitives, he certainly was not a little enraged; for he cursed by the very form that Ernulphus has left us, and not varied a tittle from that most comprehensive of imprecations. The first pits were near *Gisborough*, the seat of the *Chaloners*, who still flourish there notwithstanding his Holiness's anathema." See also *A Political Survey of Britain by John Campbell*, London 1774. 2 vol. 4to. i. p. 75, and ii. p. 20. The following passage, extracted from *Britannia, or a Chorographical description of Great Britain, by W. Camden; the third edition, by E. Gibson*, London 1753. 2 vol. fol. vol. ii. p. 910, is much to the same purpose: "This (alum) was first discovered a few years since (anno 1607) by the admirable sagacity of that learned naturalist sir Thomas Chaloner, knt. (to whose tuition his majesty [king James the First] committed the delight and glory of Britain, his son prince Henry), by observing that the leaves of trees were of a more weak sort of green here than in other places, &c."

* Taubes Abschilderung der Englischen handlung. Wien 1777. 8vo. i. p. 86. "For some time past the marquis of Lepri has farmed the alum-works at Civita Vecchia for 37,000 scudi. The Apostolical Chamber supplies the necessary wood, which the marquis must be at the expense of cutting down and transporting. About two hundred men are employed in the works; and alum to the amount of from forty-five to fifty thousand scudi is sold annually, particularly to the English and the French." See *Observations faites pendant un voyage en Italie, par le Baron de R. (Riesch)*. Dresden 1781. 2 vol. 8vo.

† Voyages metallurgiques, par M. Jars. Paris 1781. 4to. vol. iii. p. 297.

in Sweden, in 1630. Roman alum costs at present in Holland from 40 to 48 schillings per cent; that of Liege from 25 to 30; that of Smyrna from 36 to 40; and English, Danish, and Swedish alum from 30 to 35.

FALCONRY.

THE question whether Falconry was known to the ancient Greeks, has been determined in the negative by Flavius Blondus,[*] Laurentius

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[*] This author, Blondus or Biondo, describing an Italian village, says, "I shall embrace this opportunity of mentioning a new circumstance, which is, that fowling with that rapacious bird the falcon, " a diversion much followed at Arno, by the celebrated Alphonsus " king of Arragon, was entirely unknown about two hundred years " ago; for though Servius, the grammarian, says that Capua received " that name from the augury of a falcon, because the Hetruscans, " when founding it, saw one of these birds, which in their language " was called *capis*; yet he does not tell us of what use they were to " mankind. Besides, Pliny, who gives the names of many rapacious " birds of the hawk kind (*accipitres scilicet majores et minores achilvones, quos aliqui falcones fuisse volunt*), says nothing of their being " employed to catch game; and, without doubt, had fowling in this " manner been practised in the time of Virgil, he would have made " Æneas and Dido carry such birds along with them when they went " out a-hunting, whereas he says only:

" Massyliique ruunt equites et odora canum vis.

" I will venture, therefore, to affirm; that two hundred years ago, as " I have already said, no nation or people were accustomed to catch " either land- or water-fowls with any rapacious bird tamed for that

Valla,* both writers of the fifteenth century; and likewise by Rigault,† Pancirollus, Salmuth, and many others. It may, nevertheless, be here asked, what is generally understood under that term? However much the thousand barks which carried the Grecians to the siege of Troy might have been inferior to those floating castles lately seen by my countrymen before Gibraltar, they were nevertheless ships; and we cannot, on that account, deny that the Greeks were acquainted with the art of ship-building, though it was evidently then in its infancy. In the like manner, I agree with Gyraldus,‡ in allowing that they had some knowledge of falconry. I do not believe that they knew the art of hawking, that is, of chasing game with birds of prey previously trained, as practised in modern times, and which serves more for the

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" purpose." I shall here observe, that Biondo must have had a faulty copy of Pliny; for the word *achilvones* is not to be found in that author, who, nevertheless, mentions the practice of fowling with birds of prey.

* Valla, the most learned man of the century in which he lived, contradicts Antonius Renaudensis, who says: *Nola* is a hawk's bell. " If *Nola*," says Valla, " be an old word, it cannot signify that bell " now worn by hawks, because the ancients never tamed these birds " for catching game, as we do, nor ornamented them with bells. " If it be a new word, let him produce the author from whom it is " taken."——*Laurentii Vallæ Opera.* Basiliæ 1543. fol. p. 433.

† In the preface to *Scriptores rei accipitrariæ.*

‡ Lilii Greg. Gyraldi Dialogismus vi, in his works printed at Leyden 1696. fol. tom. ii. p. 870. These *dialogismi* may be found also in Gruter's *Thesaurus criticus*, vol. ii. p. 397.

amusement of trifling princes than for any useful purpose; but that they had begun to employ the rapacity of some of the winged tribe in hunting and fowling, cannot, in my opinion, be denied.[*]

So early as the time of Ctesias, hares and foxes were hunted in India, by means of rapacious birds.[†] The account of Aristotle, however, is still more to the purpose, and more worthy of notice.[‡] "In Thrace," says he, "the men go out "to catch birds with hawks.[§] The men beat the

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[*] Those who are desirous of being acquainted with the art of falconry, as practised at present, may consult *Krünitz, Encyclopedie,* xii. p. 137; *Spectacle de la nature,* vol. i.; or *C. W. J. Gatterer vom nutzen und schaden der thiere,* ii. p. 32. Also the article *Fauconnerie,* in the French Encyclopédie.

[†] Λαγωους δε και αλωπεκας ϑηρευουσιν, ου τοις κυσιν, αλλα κοραξι και ικτισι και κορωναις και αετοις. Ctesiæ Indica; Herodot. Histor. Francof. 1608. fol. p. 660.

[‡] In that part of Thrace, called formerly Cedropolis, the men go out into the marshes in quest of birds, accompanied by falcons. The men beat the trees and bushes with poles, and put the birds to flight; the hawks fly after them, by which means they are so frightened that they fall to the ground, where the men strike them with their poles, and kill them.——*Histor. animal.* lib. ix. c. 6, edit. Scaligeri.

[§] The Grecian authors above quoted call the rapacious birds used for pursuing game ιερακες; and Pliny calls them *accipitres.* It would be difficult, perhaps impossible, to distinguish with sufficient accuracy all the species of these birds to which the ancients gave different names. This genus is numerous, and the species often differ so little from each other, that it is not easy to establish their characterizing marks. Besides, they for the most part change their colour, and often their whole appearance, according to their age or the season of the year; so that these marks become very uncertain. It appears that on this account the ancients of one species often formed two or "reeds and bushes which grow in marshy places, "in order to raise the small birds, which the "hawks pursue and drive to the ground, where "the fowler kills them with poles." A similar account is to be found in another book ascribed also to Aristotle, which appears, at any rate, to be the work of an author not much younger, but with two additions, which render the circumstance still more remarkable.* The first is, that the falcons appeared when called by their names; and the second, that of their own accord they brought to the fowlers whatever they caught themselves. Nothing is here wanting but the spaniel employed to find out game, the hood which is put

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more, and imagined that many species passed into another, or that new species were produced by the mixture of different breeds. It seems, however, certain that the ancients divided those birds of prey which fly abroad in the day-time, into three species: αιετος aquila; γυψ vultur; and ιεραξ accipiter. The first and last belong to that genus which Linnæus calls *falco*, and are the large species of it. The vultures are the geir-falcons, which are sufficiently distinguished by their bald head and neck.

* Respecting Thrace which is situated above Amphipolis, a wonderful thing is related, which might appear incredible to those who had never heard it before. It is said that boys go out into the fields, and pursue birds by the assistance of hawks. When they have found a place convenient for their purpose, they call the hawks by their names, which immediately appear as soon as they hear their voices, and chase the birds into the bushes, where the boys knock them down with sticks and seize them. What is still more wonderful, when these hawks lay hold of any birds, they throw them to the fowlers; but the boys, in return, give them some share of the prey. *De mirabilibus auscultat.* cap. 128.

upon the head of the hawk while it is perched on the hand, and the thong used for holding it, to form a short description of falconry as still practised. Our falconers, when they have taken the bird from the hawk, give him, in return, a small share of it; and in the like manner the Thracian hawks received some part of their booty. Other writers after Aristotle, such as Antigonus,[*] Ælian,[†] Pliny,[‡] and Phile,[§] have also given an ac-

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[*] Antigoni Carystii Historiæ mirabiles, cap. 34.

[†] Hawks, which are no less fit for fowling than eagles, and which are not inferior to them in size, are of all birds reckoned to be the tamest and the fondest of man. I have heard, that in Thrace they accompany people when they go out in quest of birds in the fens. The fowlers, having spread their nets, remain quiet, while the hawks flying about terrify the birds, and drive them into them. When the Thracians catch any birds, they divide them with the hawks, by which means they render them faithful partners in fowling: if they did not give them a share of the booty, they would be deprived of their assistance.——*Histor. anim.* lib. ii. cap. 42.

[‡] Lib. x. c. 8. In a part of Thrace above Amphipolis, men and hawks go out a-fowling, as it were in company. The former drive the birds from among the bushes and reeds, and the latter flying after them strike them down. The fowlers divide with them their prey.—The remaining lines of this passage, *Traditum est, missas in sublime sibi excipere eos: et cum tempus sit capturæ, clangore et volatus genere invitare ad occasionem*, seem to be misplaced or mutilated, as has been already remarked by Conrad Gesner. See his *Histor. nat.* lib. iii. p. 15.

[§] Phile de animal. proprietate, according to Bersmann's translation, p. 36.

Post multinodas quam plagas venatibus
Thraces tetenderunt, latent absconditi;
Quos advolantes cominus circi juvant,
Metuque territant volucres belluas,

count of this method of fowling. Ælian, who seldom relates any thing without some alteration or addition, says, that in Thrace nets were used, into which the birds were driven by the hawks; and in this he is followed by the poet Phile. Ælian, also, in another place describes a manner of hunting with hawks in India, which, as we are told by several travellers, is still practised in Persia, where it is well understood, and by other eastern nations.*

Laxata condant subter ut se retia.
Quas Thraces arctis implicatas cassibus
Cohorte densa, comprehendunt acriter,
Circisque mercedem rependunt debitam,
His portionem largientes alitum.
Quod ni fit, ope post destitutos videris
Ponunt volantum cum laqueos rursus gregi.

Gesner has collected in the work before quoted, page 48, all the information to be found respecting that species of hawk or falcon called κιρκος, circus.

* The Indians hunt hares and foxes in the following manner. They do not employ dogs, but eagles, crows, and, above all, kites, which they catch when young, and train for that purpose. They let loose a tame hare or fox, with a piece of flesh fastened to it, and suffer these birds to fly after it, in order to seize the flesh, which they are fond of, and which, on their return, they receive as the reward of their labour. When thus instructed to pursue their prey, they are sent after wild foxes and hares in the mountains; these they follow in hopes of obtaining their usual food, and soon catch them and bring them back to their masters, as we are informed by Ctesias. Instead of the flesh, however, which was fastened to the tame animals, they receive as food the entrails of the wild ones which they have caught. *Æliani Hist. Animal.* lib. iv. c. 26. Compare with this what Pluche says in *Nature displayed*, and the accounts given by Chardin and Gemelli Carreri.

It seems therefore, that the Greeks received from India and Thrace the first information respecting the method of fowling with birds of prey; but it does not appear that this practice was introduced among them at a very early period. In Italy, however, it must have been very common, for Martial and Apuleius speak of it as a thing every where known. The former calls a hawk a fowler's servant, and the latter makes use of a kind of pun on the word *accipiter*, which signified also a species of fish.* It cannot indeed be said, that this art was ever forgotten; but, like other inventions, though at first much admired, it was afterwards neglected, so that it remained a long time without improvement. It is however certain that it was at length brought to the utmost degree of perfection. It is mentioned in the Roman laws,† and in writers of the fourth and fifth centuries.

Julius Firmicus Maternus, who in the time of Constantine the Great, about the year 336, wrote his *Astronomicon*, in which he teaches the art of casting nativities, assures us that those who are born under certain signs will become great sportsmen, and keep hounds and falcons.* Caius Sollius Apollinaris Sidonius, who lived about the year 480, celebrates Herdicius, his wife's brother, and son of the Emperor Avitus, because he first practised in his territories hunting and fowling with dogs and hawks. The same author mentions hawking also in other parts of his work.† That this diversion, however, has not been oftener spoken of and praised, needs excite little wonder. Hunting, and all the concomitant arts, were at first employed for use; in the course of time they were practised by servants, and easy means only of catching game were sought for. But when luxury was introduced into states, and the number of those who lived by other people's labour increased, these idlers began to employ that time which they had not learned to make a proper use of, or which they were not compelled to apply to more valuable purposes, in catching wild animals by every method that ingenuity could suggest, or in tormenting them by lingering deaths. Hunting and fowling, therefore, received many improvements by the assistance of art; and the indolent clergy even indulged in these cruel sports, though often forbidden by the Church. Such prohibitions were issued by the council of Agda* in the year 506; by that of Epaon† in 517, by that of Macon‡ in 585, and perhaps oftener, but never with much effect.

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* Prædo fuit volucrum, famulus nunc aucupis; idem
Decipit, et captas non sibi mœret aves.
Martial. Epigr. lib. xiv. 216.

Apuleius, who had resolved to examine every part of nature, having been accused of collecting sea-animals with indecent names for obscene purposes, makes the following reply: "Memento tamen tam ridiculum argumentum fore, desiderata ad res venereas marina obscœna, quam si dicas marinum pectinem comendo capillo quæsitum, vel aucupandis volantibus piscem accipitrem, aut venandis apris piscem apriculum, aut eliciendis mortuis marina calvaria." Apologia, p. 296.

† I allude to the words in Digest. lib. xliii. tit. 24. 22. Ne is, qui duntaxat iter per fundum meum fecerit, aut avem egerit, venatusve fuerit, sine ullo opere, hoc interdicto teneatur.

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* Those born when the planet Venus is in Aquarius will be much given to hunting and fowling; in other things they will be slow, indolent, inactive, and melancholy, and will apply to no laudable pursuit. They will, however, be fond of breeding hawks, falcons, eagles, and other birds of the like kind, and horses for hunting. They will be also very ingenious in such exercises, and acquire by them a comfortable subsistence. Lib. v. c. 7.—This nativity displays a knowledge of mankind; for one may without much difficulty find princes and great men with whose lives it exactly corresponds, and who, to the great misfortune of their subjects and tenants, have undoubtedly been born under the sign Aquarius. In the next chapter we find, "Equorum nutritores, accipitrum, falconum, cæterarumque avium quæ ad aucupia pertinent, similiter et molossorum, vertagorum, et qui sunt ad venationes accommodati." See *Firmici Astronomicon*, lib. viii. Basiliæ 1533. fol. p. 138, 139.

† Præterea, quod hic primum gramina incessu, flumina natatu, venatu nemora fregisti. Omitto, quod hic primum tibi pila, pyrgus, accipiter, canis, equus, arcus ludo fuere. *C. Sol. Apollinaris Sidon. Opera*. Parisiis 1609. 4to. lib. iii. epist. 3. See also lib. iv. epist. 9, and carmen vii. ver. 192.

Before I proceed farther, I shall make two remarks. First, that Pietro Crescentio§ gives one

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* Concilii Agathensis canone quinquagesimo quinto: "Episcopis, presbyteris, diaconibus, canes ad venandum, aut accipitres, habere non liceat."

† Concilii Epaonensis can. iv.

‡ Concilii Matisconensis secundi can. xiii: "Ubi Dei est assiduitas cantilenæ, monstrum est, et dedecoris nota, canes ibi vel accipitres habitare."

§ E di questi il primo trovatore che fu si dice il fu Dauco, il quale per divino intelletto connobbe la natura de gli sparvieri et de falconi, et quelli dimesticare et alla preda amaestrarli, et delle loro infermita di curarli; doppo il quale molti altri furono, che molti di quelli uccelli

Daucus as the inventor of the art of taming hawks, but without proof, or even probability. Secondly, that the ancients bred up to hunting and fishing several rapacious animals which at present are not used for that purpose, such as the seal * and sea-wolf.† Astruc ‡ has endeavoured to confute this idea: but his reasoning appears to me to have little weight; and I agree in opinion with Rondelet§ and Isaac Vossius‖, that seals might be instructed to catch fish; I myself have seen some, that, when commanded by their master, exhibited a variety of movements and tricks which undoubtedly prove their aptness to learn.

The art of falconry seems to have been carried to the greatest perfection, and to have been much in vogue at the principal courts of Europe, in the twelfth century. Some on that account have ascribed the invention of it to the emperor Frederic I, and others to Frederic II. Frederic I, called

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rapaci alla scientia aggionsono. *Pietro Crescentio d'agricoltura.* In Venetia 1542. 8vo. lib. ix. c. 1. Equally groundless is what we read in *Johannis Sarisberiensis Policraticus.* Amstelod. 1664. 8vo. lib. 1. cap. iv. Venationis aëreæ auctorem jactitant fuisse Machabeum, &c.

* Plin. lib. ix. cap. 8. Ælian. Hist. anim. l. ii. c. 11. Oppiani Halieut. l. v. 425.

† Plin. lib. x. cap. 8. Aristot. Hist. anim. l. ix. c. 36. Ælian. Hist. anim. l. vi. c. 65. Antigonus Caryst. cap. 33.

‡ Mémoires pour l'histoire naturelle de la province de Languedoc. Paris 1737. 4to. p. 568.

§ De piscibus, lib. xvi. cap. 8.

‖ In his observations on Mela, ii. 5. p. 483.

Barbarossa, was the first who brought falcons to Italy; at least Pandolfo Collenuccio[*] says, that this was the common report, and Radevicus[†] seems to confirm it; but I do not know from what authority Pancirollus tells us that that emperor invented falconry at the time when he was besieging Rome. Rainaldo, marquis of Este, was the first among the Italian princes who used this method of fowling;[‡] and that the emperor Henry followed the example of his father, seems proved by the words of Collenuccio. The service rendered by Frederic II to this art, if it can be said to deserve service, is shown by the book which he wrote in Latin on it, entitled *De Arte venandi cum avibus*, and which was printed for the first time at Augsburg in the year 1596, from a manuscript belonging to Joachim Camerarius, a physician of Nuremberg.* It has here and there deficiencies, because the manuscript was torn, and some additions by the author's son Manfred, king of Sicily. In the second book, there is an account of the use and manner of making hoods, called *capellæ*, which we are there told were invented by the Arabs. The emperor received as a present some hooded falcons from Arabian princes, and procured people from Arabia who understood the management of them.† Albertus Magnus has inserted a great deal from the work of this emperor in his book upon animals.

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[*] Fu (Enrico) dato estremamente all' essercitio della caccia, et dell' uccellare con falconi, et uccelli di rapina; il qual modo d'uccellare, è fama, che Federico suo padre fosse il primo autore, che lo portasse in Italia. *Compendio dell' istoria del regno di Napoli, di Pandolfo Collenuccio, di Mambrino Roseo e di Tom. Costo.* In Venetia 1613. 4to. i. p. 88.

[†] In equis, canibus, accipitribus, cæterisque ejus generis avibus instituendis, spectandis, circumferendis, nulli secundus. *Radevicus de gestis Frederici* I. lib. ii. cap. ultimo.

[‡] Aves autem aucupio natas, accipitres videlicet, falcones, girofalcos, peregrinos, montanos, gibbosos, astures, quos Pausanias astorgios vocat, quæ primus in Italiam longo postliminio Fredericus Ænobarbus advexit, ac cicures effici edocuit, primusque ex Italia Rainaldus marchio Estensis apud se in delitiis habuit, ad centum quinquaginta magnis expensis aluit. *Bandellus Dominicanus, Orat. funebr. in princip. Mantuanum.*

Rhainaldus inter Italos omnium primus accipitres cicures, astures et id genus aquilas aluit, atque in delitiis habuit. *Cynthii Joan. Baptistæ Gyraldi de Ferraria et Atestinis princip. commentariolum, in Grævii Thesauro antiquit. et historiar.* vol. vii. p. 12.

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* Reliqua librorum Frederici II imperatoris de arte venandi cum avibus, cum Manfredi regis additionibus;—ex membranis vetustis nunc primum edita. Albertus M. de falconibus, asturibus, et accipitribus. Augustæ Vindel. ad insigne pinus 1596. 414 pages 8vo.

† As this work is extremely scarce, I shall here quote the following passage from it: "The hood had its origin among the oriental nations; for the eastern Arabs used it more than any other people with whom we are acquainted, in taming falcons and birds of the same species. When I crossed the sea, I had an opportunity of observing that the Arabs used hoods in this art. Some of the kings of Arabia sent to me the most expert falconers, with various kinds of falcons; and I did not fail, after I had resolved to collect into a book every thing respecting falconry, to invite from Arabia and every other country such as were most skilful in it; and I received from them the best information they were able to give. Because the use of the hood was one of the most effectual methods they knew for taming hawks, and as I saw the great benefit of it, I employed a hood in training these birds; and it has been so much approved in Europe, that it is proper it should be handed down to posterity."

In none of the sports of the field have the fair sex partaken so much as in falconry. The ladies formerly kept hawks, in which they greatly delighted, and which were as much fondled by those who wished to gain their favour as lap-dogs are at present.[*] What tended principally, however, to bring it into disuse, was the invention of gunpowder. After that, hawks were discarded, and the whole enjoyment of fowling was confined to shooting. Less skill and labour was indeed required in this new exercise; but the ladies abandoned the pleasures of the chase, because they disapproved of the use of fire-arms, which were attended both with alarm and danger.

Among the oldest writers on Falconry, we may reckon Demetrius, who about the year 1270 was physician to the emperor Michael Paleologus. His book, written in Greek, was first printed at Paris in 1612, by Nicholas Rigaltius, from a manuscript in the king's library, and with the Latin translation of Peter Gyllius.[†] Some other works on the same subject, the antiquity of which is unknown, were printed at the same time. One in the Catalonian dialect has the forged title of *Epistola Aquilæ, Symmachi et Theodotionis ad Ptolemæum regem Ægypti de re accipitraria.* All these writings treat chiefly on the rearing and diseases of hawks; and contain cures, which, though some of them perhaps may be good enough, would not undoubtedly be all approved by any person of skill at present.* Aloes, to the size of about a bean, are ordered as a purge; and quicksilver is prescribed for the itch and outbreaking. We are told also, that a wild and untractable falcon was confined some time with a hood on in a smith's shop, where it was soon tamed by the continual thumping of the hammers. One precept in Demetrius, respecting the art of falconry, seems very ill suited to the practice of modern times. He desires sportsmen to say their prayers before they go out to the field.† Had this custom been continued to the present day, many great men would be like the people mentioned by a certain traveller, who solicit the assistance of God when they are preparing for a piratical expedition;[*] but with this difference, that these rovers plunder only strange ships, whereas the latter destroy the property and possessions of their own subjects.

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[*] *Mémoires sur l'ancienne chevalerie, par M. de la Curne de Sainte-Palaye.* Paris 1759—1781. 3 vol. 12mo. tom. iii. p. 183. In this work may be found many anecdotes respecting the taste of the French ladies for the sports of the field, in the ages of chivalry.

[†] 'Ιερακοσοφιον. Rei accipitrariæ scriptores nunc primum editi. Accessit Κυνοσοφιον, Liber de cura canum. Lutetiæ 1612. 4to. See *Fabricii Biblioth. Græca*, lib. i. c. 25. vol. i. 155, where, however, the year 1619 is given wrong.

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* Among certain miscellany tracts, written by Thomas Brown, London 1684, 8vo. p. 111, there is one with the following title: *Of hawks and falconry, ancient and modern*; which, however, consists only of old medical prescriptions. I mention this circumstance, because Grævius, in the preface to that part of his *Thesaurus*, page 6, where he gives some account of the history of falconry, laments that, on account of his being unacquainted with the English language, he had not been able to make use of this treatise of Brown.

† Τον ϑεον επικαλεσαντες.

TURF.

The observation, that many kinds of earth, when dried, might be employed as fuel, may have easily been occasioned by an accident in some place destitute of wood. A spark falling fortuitously on a turf-moor, during a dry summer, often sets it on fire, and the conflagration it occasions generally lasts so long, that it cannot escape notice.[†] Of the earth taking fire in this manner, there are many instances to be found in the ancients. One of the most remarkable is that mentioned by Tacitus,* who relates, that not long after the building of the city of Cologne, the neighbouring land took fire, and burned in such a manner, that the corn, villages, and every production of the fields were destroyed by the flames, which advanced even to the walls of the city. I agree in opinion with Mr. Habel, who has lately quoted this remarkable passage,† that it is not to be understood as alluding to a volcanic eruption, but to a morass which had been set on fire. In the duchy of Berg, and around Cologne, there are very extensive morasses, from which turf is dug up for fuel, and which undoubtedly serve to confirm this idea.

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[*] Remarques d'un voyageur moderne au Levant. Amsterdam 1773. 8vo.

[†] In Siberia, a village which stood on a turf-moor was, on account of its marshy situation, removed to another place; and that the remains might be more easily destroyed, they were set on fire. The flames, having communicated to the soil, which was inflammable, occasioned great devastation; and when Gmelin was there, it had been continually burning for half a year. See *Gmelin's Reisen durch Russland in den jahren* 1768 *und* -69; vol. i. p. 22.

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* Civitas Juhonum malo improviso afflicta est; nam ignes terra editi villas, arva, vicos passim corripiebant, ferebanturque in ipsa conditæ nuper Coloniæ mœnia, neque extingui poterant, non si imbres caderent, non si fluvialibus aquis aut quo alio humore niterentur; donec inopia remedii et ira cladis agrestes quidam eminus saxa jacere, dein residentibus flammis propius suggressi, ictu fustium, aliisque verberibus, ut feras absterrebant; postremo tegmina corpori direpta injiciunt, quanto magis profana et usu polluta, tanto magis oppressura ignes. *Tacit. Annal.* lib. xiii. cap. 57. According as I understand the last words, the rustics, in despair, when they found that the fire could not be quenched either by rain or by the river-water which they poured over it, flung at last stones upon it, and throwing themselves over these, closed up with their clothes, which were made of skins, all the interstices between them; and these means may have been assisted by their pressure on the earth. I doubt, therefore, whether this circumstance can be referred, as Mr. Habel thinks, to the superstitious custom of throwing certain trifling things into fires in order to extinguish them.

† Beyträge zur naturgeschichte und œconomie der Nassauischen länder. Dessau 1784. 8vo. p. 25. Some account of the turf morasses near Cologne may be found in *Hupsches Entdeckung des ursprungs des Cölnischen umbers.* Frankf. und Leipzig 1771. 8vo.

That the use of turf was well known in the earliest periods, in the greater part of Lower Saxony, and throughout the Netherlands, is fully proved by Pliny's account of the Chauci, who inhabited that part of Germany which at present comprehends the duchies of Bremen and Verden, the counties of Oldenburg, Delmenhorst, Diepholz, Huy and East Friesland. Pliny says expressly, that the Chauci pressed together with their hands a kind of mossy earth, which they dried by the wind rather than by the sun, and which they used not only for cooking their victuals, but also for warming their bodies.* I explain also by turf a short passage of Antigonus Carystius, quoted from Phanias, in which it is said that a morass in Thessaly, having become dry, took fire and burned.†

The account, therefore, given in some Dutch chronicles, that turf and the manner of preparing it were first found out about the year 1215, and that about 1222 it had become common, is certainly false.* This information may be applicable to certain lands and districts, and correct as to the

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* Captum manibus lutum ventis magis quam sole siccantes, terra cibos et rigentia septentrione viscera sua urunt. *Hist. nat.* lib. xvi. c. 1.

† Φανιαν δε, την των Πυρακων λιμνην όταν αναξηρανθη, καεσθαι. Phaniam, paludem Pyracum, siccatam ardere. Meursius says that the reading ought to be των Πυῤῥαιων, and he is of opinion that it means a part of Thessaly called by Stephanus Πυῤῥαια.

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* De Wolt-luyden, die nu nieuwe manieren van goed te ghewinnen, in het graven van den torff, gevonden hadden, in voortiiden onbekent, ofte ten minsten so seer ghemeen niet, hebben oock uyt goeden yver ten tiiden van den Abt Siardus, de seer goddienstich ende nederich was, het Clooster Mariengaerd veele veenen in ende ontrent Beccafeen geschonken. "The foresters, who had then got a new employment, that of turf-digging, which had been before unknown, or at least very uncommon, gave as a present to the monastery of Mariengard, in 1215, several turf-mosses in and near Backefeen." That monastery was situated at the distance of two miles from Leeuwaarden. The words *Wolt-luyden*, *Wout-lieden*, *Woudlieden*, occur in the old laws of the mines of Goslar, which Leibnitz has inserted in *Scriptor. Brunsv.* vol. iii. In the introduction it is said, Sylvani, qui in legibus vocantur *die Woltleute* item *Woldwerchten* id est *Waldgewerke*. Eorum sub nomine continentur et montani, seu homines in metallis seu fodinis et officinis fusoriis occupati, qui passim per sylvas vicinas dispersi agebant. Nam in legibus metallicis diserte cavetur, ut, quando de novis legibus ferendis agitur, Sex-viri convocent Sylvanos, et quod pluribus placuit sequantur.

In *Kronijck der Kronijcken, door S. de Vries*, printed at Amsterdam in 1688, in five volumes 4to. the following passage occurs, vol. v. p. 553: Ontrent dese tijd (1221) is de turf-gravingh eerst regt opgekoomen; welck de geleedene schade en ellende door de zee-wateren eenigsins vergoedede en versoetede; waer door oock veele seer riick wierden. "About this time (1221) the digging of turf was first practised, which in some measure made amends for the damage occasioned by the sea-water, and by which several acquired great riches."

Some Dutch writers make turf-digging to be of much higher antiquity, and in support of this opinion quote an old chronicle in rhyme, in which mention is made of a donation by Gerolf count of Friesland, in the following words: *Dat hi gaf bosch, marsch ende zant.* They explain *m*[illegible]*rgrond*, moss; but I am not acquainted with the ant[illegible] chronicle; and of the [illegible] donation there is only [illegible]nslation, which, with some extracts from the chron[illegible]ound in *D'oude chronijcke end* introduction of this kind of fuel in those parts; for the use of it was not extended far till a late period; and even yet, turf is neither employed nor known in many places which possess it, even though they are destitute of wood.* Some improvement in the manner of preparing turf may have also been considered as the invention of this fuel, which is undoubtedly of greater antiquity. What induced Monconys to ascribe the invention of turf to Erasmus, or who first propagated that error, I can as little conjecture as Misson.†

In latter times turf began to be burned to coal, sometimes in kilns, and sometimes in furnaces built for that purpose, by which this advantage is obtained, that it kindles sooner, burns with less air, and forms a more moderate and uniform fire, without much smoke, though it is not so lasting as turf, because it has lost the greater part of its inflammable substance. This method of reducing turf to coal, which is still practised in some parts of Bohemia, Silesia, and Upper Saxony, was, it appears, proposed about the year 1669, by the well-known John

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historien van Holland, door W. van Gouthoeven. Tot Dortrecht, 1620. fol. p. 237. See also *Natuurlyke historie van Holland, door J. le Francq van Berkhey Tweede deel.* Amsterd. 1769. 8vo. p. 552.

* The use of turf was first made known in France in the year 1621, by Charles de Lamberville, advocate of the parliament of Paris, who resided some time in Holland, to which he had been sent by the king on public business. See *Anciens mineralogistes, par Gobet,* i. p. 302.

† Journal des voyages de Monconys. Lyon 1666. 2 vol. 4to. ii. p. 129. C'est lui (Erasme) qui a donné l'invention de la tourbe, qu'on brusle au lieu du charbon. See also Misson's Travels.

Joachim Becher, who recommended at that time a method of depriving coals of their sulphur by burning them, and the use of rock-oil procured from them by that process.* The burning of turf to coal seems to have been first made known in Germany by Hans Charles von Carlowitz, chamber-counsellor, and principal surveyor of the mines of the electorate of Saxony. To save wood and promote the benefit of the mines, he sought for turf; and having discovered it, he then endeavoured to find out some method of rendering it fit to be employed in the melting-houses, and this was the reducing to coal, which, as he himself says,* he first attempted in kilns at Scheibenberg, in the year 1708.

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* "In Holland there is turf, and in England there are coals, neither of which are good for burning either in apartments or in melting-houses. I have, however, discovered a method of burning both these to good coals, so that they shall not only produce no smoke or bad smell, but yield a heat as strong for melting metals as that of wood, and throw out such flames that a foot of coal shall make a flame ten feet long. This I have demonstrated at the Hague with turf, and proved here in England with coals, in the presence of Mr. Boyle, by experiments made at Windsor on a large scale. It deserves to be remarked on this occasion, that as the Swedes procure their tar from fir wood, I have procured tar from coals, which is in every thing equal to the Swedish, and even superior to it for some purposes. I have tried it both on timber and ropes, and it has been found excellent. The king himself ordered a proof of it to be made in his presence. This is a thing of very great importance to the English, and the coals after the tar has been extracted from them are better for use than before." *Narrische weisheit und weise narrheit.* Frankfurt 1683. 12mo. p. 91. Boyle seems to speak of this invention in *The usefulness of natural philosophy*, London 1774, fol. i. p. 515, or the Latin translation *Exercitationes circa utilitatem philosophiæ nat. experimentalis*, Genevæ 1694, 4to. p. 245. At present, the burning of coals in order to procure from them rock-oil, used particularly by the leather-manufacturers, and which on that account must not be exported, is much practised in England. It appears, however, that something of the like kind was attempted before Becher's time; for in the year 1627, John Hacket and Octav. Strada obtained a patent for their invention of rendering coals as useful as wood for fuel in houses without hurting any thing by their smoke. See *Anderson's History of Commerce.*

ARTICHOKE.

That I might be able to investigate whether our artichoke was known to the ancients, I have not only collected a variety of scattered passages, compared them with one another and with nature, and laboured through a tedious multitude of contradictions and a confusion of names; but I have also been obliged to examine a load of groundless conjectures, heaped together by commentators,† in order that I might understand them and ascertain their value. By these means, I have learned more than seems hitherto to have been known; and I have found that more is believed than can be proved; but that the fruits of my toil will give complete satisfaction to my readers, I do not pretend to hope. Before the botany, however, and the natural history in general of the ancients can be properly elucidated; before truth can be separated from falsehood; what is certain from what is uncertain; and things defined from those which are undefined, researches of this kind must be undertaken, and the same method as that which I have followed must be adopted.

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* Von Carlowitz, Sylvicultura œconomica, oder wild baum zucht, Leipzig 1713, fol. p. 430, where an account is given of the first experiment.

† See J. Bodæus a Stapel, Erklärung über die geschichte der pflanzen des Theophrast, p. 618. Salmasius ad Solinum, p. 150, and his Exercitationes de homonymis, p. 76. Casauboni Animadversiones in Athen. Dipnosoph. Lugduni 1621, fol. p. 146. J. Bauhini Histor. plant. iii. p. 48.

As all those, perhaps, who have a taste for illustrations of ancient authors, may not be so well acquainted with the nature, properties, culture and use of our artichoke, as the dissertation I propose may require, I shall endeavour to supply that deficiency. Our artichoke appears to those who have not studied the natural classification of plants to have an affinity to the thistle kind, and the calyx and leaves seem to warrant this opinion; the former by its scale-disposed figure, as well as the flower it contains; and the latter by their prickles, which they, however, lose by art and cultivation. The seeds which are procured from Italy, because they do not ripen with us, are sown in the spring. Of the young plants, those alone which are prickly are transplanted: the rest are thrown away, as they would produce only small tops. When the plants grow up, they shoot forth slips, which are taken up, and which may be transplanted throughout the whole summer. The calyx, before the blue flowers burst out, is cut off, and dressed sometimes fresh, and sometimes it is pickled for the winter. The only part eatable is the thick pulpy bottom, which supports the flowers with their then imperfect seeds and the woolly substance which adheres to them. Another species of the same genus, the *cynara cardunculus*, cardoons, or Spanish cardoons, is reared in our gardens, not on account of its flower, but of the pulpy ribs of its leaves, and tender stalk. When this plant attains the height of about six feet, it is bound round in such a manner that the leaves are compressed to the stem. It is then surrounded with earth and dung, and under this covering it in a few weeks becomes so white and tender, that the above-mentioned parts may be dressed and eaten, or made into soup. The ribs of the leaves, however, of the first kind, or proper artichoke, may be rendered eatable in the same manner, and are then as fit for use as the latter.

The names of plants in ancient authors which have been applied to our artichoke, are the following: *cinara*, *carduus*, *scolymus*, and *cactus*.

The *cinara*, which is originally a Greek word,* belonged certainly to the thistle-species; and the description of its top, as given by Columella,[*] seems, as has already been remarked by Nonnius[†] and others, to agree perfectly with that of our artichoke. The *cinara* was commonly furnished with prickles, but that was preferred which had lost them by cultivation, and for which, means were prescribed that did not produce the desired effect.[‡] It was raised from seed sown in spring, but was propagated also from slips or shoots which in Italy were planted in autumn, that they might bear earlier the next summer.[§] The direction given to water these plants frequently, is still followed by our gardeners in respect to their artichokes, and they expect from this attention, that the fruit will be more abundant and tender. By this method many give to their artichokes a superiority which others that have not been watered so carefully cannot attain.[*] A complaint, which occurs in ancient authors, is also prevalent, that the roots are often destroyed by mice.[†] I do not, however, find it remarked what part of the *cinara* was properly used, but it may be conjectured it was the top, because the tender fruit is praised.[‡]

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* In the time of Galen and Athenæus it was written sometimes κιναρα, and sometimes κυναρα. *Salmasius de homonymis*, p. 77.

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[*] Hispida ponatur cinara, quæ dulcis Iaccho
Potanti veniat, nec Phœbo grata canenti.
Hæc modo purpureo surgit glomerata corymbo,
Myrtiolo modo crine viret, deflexaque collo
Nunc adaperta manet, nunc pinea vertice pungit,
Nunc similis calatho, spinisque minantibus horret,
Pallida nonnunquam tortos imitatur acanthos.

Colum. lib. x. ver. 235.

These lines are not perfectly clear, as the learned editor himself confesses. I read *adaperta*, on the authority of an ancient manuscript, and have therefore inserted it in the above passage.

[†] Hanc descriptionem optime quadrare cum planta illa quæ vulgo Artachoches dicitur, nemo est qui negabit, modo Columellæ versus cum ipsa planta conferre voluerit. *Ludovici Nonnii Diæteticon, sive de re cibaria.* Antverpiæ 1646. 4to. p. 56.

[‡] It was said, that if the corners of the seeds were bruised, no prickles would be produced. See *Geopon.* lib. xii. cap. 39.

[§] Cinaræ sobolem melius per autumni æquinoctium disponemus; semen commodius circa calendas Martii seremus. *Geopon.* l. c. *Columella*, xi. cap. 3.

Carduus, among the Romans, was the common name of all plants of the thistle kind. It occurs among those of weeds,[§] and may be then properly translated by the word *thistle*. It, however, often signified an eatable thistle; and this has given Pliny occasion to make use of an insipid piece of raillery, when he says, that luxury prepared as food to man what would not be eaten by cattle.[||]

It is an old and common fault, that when the

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[*] Æstate rigato ipsas, et quidem frequenter. *Geopon.* p. 925.

[†] Geopon. 926.

[‡] Geopon. 925, where repeated watering is directed, it is said: Ὀυτω γαρ ἁπαλον και αδρυτερον τον καρπον ἑξεις; you will then have tenderer fruit, and in more abundance.

[§] Virgil. Geórg. i. 150. Plin. lib. xviii. cap. 17.

[||] Poterant videri dicta omnia quæ in pretio sunt, nisi restaret res maximi quæstus, non sine pudore dicenda. Certum est quippe carduos apud Carthaginem magnam, Cordubamque præcipue, sestertium sena millia e parvis reddere areis; quoniam portenta quoque terrarum in ganeam vertimus, etiam ea quæ refugiunt quadrupedes consciæ. *Plin.* lib. xix. cap. 8.

Greek and Roman authors have not given us such descriptions of natural objects as are sufficient to enable us to ascertain exactly what they are, we suppose that they have been known under different names, and a variety of characteristics are drawn together to enable us to determine them. What, for example, we find respecting the *cinara* is too little to give a just idea of the plant; we read somewhat more of the *carduus*; and because between these there seems to be an affinity, it is concluded that the *cinara* and the *carduus* were the same plant; and every thing told us respecting both of them is thrown into one. Some even go further, and add what they find under a third or a fourth name. It is indeed true, that many natural objects have had several names, and the species may sometimes be rightly guessed: but conjecture ought never to be admitted unless the identity can be fully established; else one may form such a monstrous production as Horace has delineated, when he says,

> Humano capiti cervicem pictor equinam
> Jungere si velit, et varias inducere plumas,
> Undique collatis membris—

I wish commentators would follow the example of our naturalists, who consider a plant as a distinct species until it has been proved, on sure grounds, that it is nothing else than a variety of a plant already characterized. I should not therefore affirm, that the *cinara* and the *carduus* are the same, were I not able to produce the following incontestable proofs in support of my assertion.

In the first place, the Latins, Palladius and Pliny, give us the same account of the *carduus* that Columella and the Greeks do of the *cinara*. The former lost its prickles through cultivation;* its flowers were also of a purple colour;† it was propagated by seed and by shoots;‡ it required frequent watering;§ and it was remarked that it throve better when the earth was mixed with ashes.|| Had not the *carduus* and the *cinara* been the same, Palladius and Pliny would have mentioned the latter; for we cannot suppose that they otherwise would have omitted a plant that formed a dish so much esteemed and so well known among their countrymen. The latter claims to himself

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* Palladius, iv. 9. p. 934, and lib. xi. Octob. p. 987. In the first-mentioned place he gives the same direction for preventing prickles, as that quoted respecting the *cinara*. "Si acumina seminum confringas, spinis carebunt."

† Florem purpureum mittit inter medios aculeos, celeriter canescentem et abeuntem cum aura. "The wind easily carries away the withered flowers on account of their woolly nature." *Plin.* lib. xx. cap. 23.

‡ Pallad. l. c.

§ Pallad. p. 934, Rigentur, si æstus intervenit.

|| Pallad. xi. Octob. xi. p. 987: Cinerem sæpe sub hieme diebus siccis, fimumque miscebimus. *Columella*, lib. xi. cap. 3, speaking of *cinara*, says, Multo cinere stercorabimus; id enim genus stercoris huic oleri videtur aptissimum. The same thing is said by the Greeks.

tainly false.* This information may be applicable to certain lands and districts, and correct as to the

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* De Wolt-luyden, die nu nieuwe manieren van goed te ghewinnen, in het graven van den torff, gevonden hadden, in voortiiden onbekent, ofte ten minsten so seer ghemeen niet, hebben oock uyt goeden yver ten tiiden van den Abt Siardus, de seer godsdienstich ende nederich was, het Clooster Mariengaerd veele veenen in ende ontrent Beccafeen geschonken. " The foresters, who had then got a new employment, that of turf-digging, which had been before unknown, or at least very uncommon, gave as a present to the monastery of Mariengard, in 1215, several turf-mosses in and near Backefeen." That monastery was situated at the distance of two miles from Leeuwaarden. The words *Wolt-luyden*, *Wout-lieden*, *Woudlieden*, occur in the old laws of the mines of Goslar, which Leibnitz has inserted in *Scriptor. Brunsv.* vol. iii. In the introduction it is said, Sylvani, qui in legibus vocantur *die Woltleute* item *Woldwerchten* id est *Waldgewerke.* Eorum sub nomine continentur et montani, seu homines in metallis seu fodinis et officinis fusoriis occupati, qui passim per sylvas vicinas dispersi agebant. Nam in legibus metallicis diserte cavetur, ut, quando de novis legibus ferendis agitur, Sex-viri convocent Sylvanos, et quod pluribus placuit sequantur.

In *Kronijck der Kronijcken, door S. de Vries,* printed at Amsterdam in 1688, in five volumes 4to. the following passage occurs, vol. v. p. 553: Ontrent dese tijd (1221) is de turf-gravingh eerst regt opgekoomen; welck de geleedene schade en ellende door de zee-wateren eenigsins vergoedede en versoetede; waer door oock veele seer riick wierden. " About this time (1221) the digging of turf was first practised, which in some measure made amends for the damage occasioned by the sea-water, and by which several acquired great riches."

Some Dutch writers make turf-digging to be of much higher antiquity, and in support of this opinion quote an old chronicle in rhyme, in which mention is made of a donation by Gerolf count of Friesland, in the following words: *Dat hi gaf bosch, mersch ende zant.* They explain *mersch* by *moergrond,* moss; but I am not acquainted with the antiquity of that chronicle; and of the letter of donation there is only a Flemish translation, which, with some extracts from the chronicle, may be found in *D'oude chroniicke end* introduction of this kind of fuel in those parts; for the use of it was not extended far till a late period; and even yet, turf is neither employed nor known in many places which possess it, even though they are destitute of wood.* Some improvement in the manner of preparing turf may have also been considered as the invention of this fuel, which is undoubtedly of greater antiquity. What induced Monconys to ascribe the invention of turf to Erasmus, or who first propagated that error, I can as little conjecture as Misson. †

In latter times turf began to be burned to coal, sometimes in kilns, and sometimes in furnaces built for that purpose, by which this advantage is obtained, that it kindles sooner, burns with less air, and forms a more moderate and uniform fire, without much smoke, though it is not so lasting as turf, because it has lost the greater part of its inflammable substance. This method of reducing turf to coal, which is still practised in some parts of Bohemia, Silesia, and Upper Saxony, was, it appears, proposed about the year 1669, by the well-known John

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historien van Holland, door W. van Gouthoeven. Tot Dortrecht, 1620. fol. p. 237. See also *Natuurlyke historie van Holland, door J. le Francq van Berkhey Tweede deel.* Amsterd. 1769. 8vo. p. 552.

* The use of turf was first made known in France in the year 1621, by Charles de Lamberville, advocate of the parliament of Paris, who resided some time in Holland, to which he had been sent by the king on public business. See *Anciens mineralogistes, par Gobet*, i. p. 302.

† Journal des voyages de Monconys. Lyon 1666. 2 vol. 4to. ii. p. 129. C'est lui (Erasme) qui a donné l'invention de la tourbe, qu'on brusle au lieu du charbon. See also Misson's Travels.

sting when the plant withered.* It flowered the whole summer through, and had often flowers and ripe seed at the same time; which is the case also with our artichoke plants.† The calyx of the *scolymus* was not prickly;‡ the root was thick, black, and sweet, and contained a milky juice. It was eaten both raw and cooked; and Theophrastus observes, as something very remarkable, that when the plant was in flower, or, as others explain the words, when it had finished blowing, it was most palatable. What renders this circumstance singular is, that most milky roots, used for food, lose their milk and become unfit to be eaten as soon as they have blown. This is the case with the goat's beard, which is eatable only the first year.

The *scolymus*, however, is not the only plant which forms an exception; for the garden scorzónera retains its milk, and continues eatable after it has bloomed, and as long as it has milk it may be used. According to Theophrastus and Pliny, the roots of the *scolymus* are eatable. On the other hand, Dioscorides says, that the roots were not eaten, but the young leaves only: as he informs us, however, that they were dressed like asparagus, it would appear that he meant the young shoots.[*] Theophrastus expressly tells us, that, besides the roots, the flowers [†] also were used as food; and he calls that which was eatable the pulpy part. We have, therefore, full proof that the ancients ate the tops of some plants, in the same manner as we eat our artichokes.

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* Aculei arescente folio desinunt pungere. *Plin.* lib. xxi. cap. 16.

† Mirum quod sine intervallo tota æstate aliud floret in eo genere, aliud concipit, aliud parturit. *Plin.* lib. c. Theophrastus says the same, p. 613.

‡ Theophrastus: ἡ δε κυησις ουκ ακανθωδης, αλλα προμηκης αυτου. Conceptus non spinosus, sed oblongus. But Dioscorides says, κεφαλη ακανθωδης, capitulum spinosum. This contradiction, and other small variations, have induced some to consider the *scolymus* of Theophrastus, and that of Dioscorides, as two different plants.

It may, however, be asked, what kind of a plant was the *scolymus*?—That it was different from the *cinara* is undoubtedly certain; for Dioscorides [‡] expressly distinguishes them; nor was it the eatable *carduus*, for Pliny compares it with the *carduus*, [§] and says that it was characterized from the latter by having roots fit to be eaten. [‖] Stapel is of opinion that the *scolymus* is our artichoke; but this seems to me improbable, for the leaves and roots of the latter are not sweet, but harsh and bitter, and the calyx is prickly, which was not the case in the *scolymus* of Theophrastus. Besides, I find nothing in the whole description of the *scolymus* or in the accounts given us by the ancients of the *cinara* and *carduus*, that can be applied to our artichoke alone, and not to any other plant. It may be here replied, that it would be very difficult to ascertain plants from the names of the ancients, were such strong proofs required, because they had not the art of separating the different genera correctly, and of assigning to each certain characterizing marks. This I allow; and for that reason it is impossible to elucidate properly the Greek and Latin names of plants; but, in my opinion, it is better to confess this impossibility, than to deceive oneself with distant probabilities. Let the genus be ascertained when one cannot ascertain the species; let the order to which the plant belongs be determined when one cannot determine the genus; or, at least, let the class be assigned when there is sufficient authority to do so. The *cinara*, *carduus*, and *scolymus* were, therefore, species of the thistle, of which the roots and young shoots, and also the bottom of the calyx of the last, were eaten. Were I appointed, or condemned, to form a new Latin dictionary, I should explain the article *scolymus* in the following manner: *Planta composita, capitata. Caulis longus, obsitus foliis spinosis. Radix carnosa, lactescens, nigra, dulcis, edulis. Calix squamis inermibus, disco carnoso, ante efflorescentiam eduli. Semina paposa. Turiones edules.* This description, short as it is, contains every thing that the ancients have said in order to characterise that plant. It can, indeed, be understood only by those who are acquainted with the terms of botany; but what follows will require no explanation, or defining of botanical names.

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[*] Ἡ δε ποα αρτιφυης ουσα, λαχανευεται ἑφθη ὡσπερ ασπαραγος. Herba vero recens nata, si asparagi modo elixetur, oleris vicem subit. *Dioscor*. iii. 16.

[†] Ἡ δε του ογκου κυησις σαρκωδης και εδωδιμος. Pars crassior carnosa, ciboque idonea.

[‡] Dioscor. lib. iii. cap. 10, where he says of a plant that its leaves were like those of the σκολυμος, and its stem like that of the κιναρα.

[§] Lib. xxi. cap. 16.

[‖] Scolymus carduorum generis ab iis distat, quod radix ejus vescendo est decocta. Pag. 250.

Should it be said that the *scolymus* must be our artichoke, because no other plant of the thistle kind is known the bottom of the calyx of which is eatable, I would in answer observe:—First, other species may have been known in ancient times, which, perhaps, have been disused and forgotten since the pleasanter and more delicious artichoke became known. It is certain that many old plants have in this manner been banished from our gardens by the introduction of new ones. Thus have common alexanders [*] fallen into neglect since celery was made known by the Italians, about the end of the 17th century; and so at present has the cultivation of winter-cresses,[†] bulbous-rooted chærophyllum,[‡] rocket,[§] and others, been abandoned since better vegetables have been obtained to supply their place. Secondly, it is certain that, even at present, the bottom of the calyx of some others of the thistle-kind, besides the genus of the artichoke, is eaten; such as the cotton-thistle,[‖].

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[*] Smyrnium olusatrum. See my Grundsätze der Teutschen landwirthschaft, p. 117.

[†] Erysimum barbarea.

[‡] Chærophyllum bulbosum.

[§] Brassica eruca.

[‖] Onopordum acanthium. See Halleri Hist. plant. i. p. 69. Linnæi Amoen. academ. vol. vi. p. 194.

and the carline thistle,* without mentioning the sun-flower, which has been brought to us in modern times from South America.

Without engaging to examine all the hypotheses of commentators and ancient botanists on this subject, I shall take notice of one conjecture which, upon mature consideration, appears to have some probability. Clusius † is of opinion that the plant called by the botanists of the 17th century *carduus chrysanthemus*, and by those of the present age *scolymus Hispanicus*, the golden thistle, is the *scolymus* of Theophrastus; because its leaves, beset with white prickles, and its pulpy, sweet, milky roots are eaten, and excel in taste all roots whatever, even those of skirret; and because it was collected and sold in Spain, Italy, and Greece. But what has principally attracted my attention to this conjecture, is the account of Bellon ‡ that this plant in Crete or Candia is called still by the Greeks there *ascolymbros*. This name seems to have arisen from *scolymos*; and besides Stapel[*] found in an old glossary the word *ascolymbros*. I am likewise convinced that, as Tournefort[†] has said, the botany of the ancients would be much illustrated and rendered more certain, were the names used by the modern Greeks known. It is certain that many old names have been preserved till the present time with little variation; but, nevertheless, I can as little admit the assertion of Clusius as that of Stapel; for *scolymus hispanicus* has neither the bottom of the calyx pulpy, nor wool adhering to the seeds, like the *scolymus* of Theophrastus; and the young roots only can be eaten, because, like those

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* Carlina acaulis. Haller. l. c. p. 80. Lin. l. c.

† Clusii Rariorum plantarum historiæ, lib. iv. p. 153.

‡ In Crete there is a kind of prickly plant, which, in the common Greek idiom, is generally called *ascolimbros*. The ancient Latins called it also by a Greek name, *glycyrrhizon*, though different from *glycyrrhiza* (liquorice). It grows every where spontaneously, has a yellow flower, and abounds with a milky juice. The roots and leaves are usually eaten before it shoots up into a stem. We saw it exposed to sale, with other herbs, in the market-place of Ravenna, and at Ancona, where the women, who were digging it up, gave it the name of *riuci*. We saw it gathered also in the Campagna di Roma, where the inhabitants called it *spinaborda*. This is the plant which by the modern Greeks is named *ascolimbrous*. *Bellonii Observationes*, lib. i. cap. 18, added to *Clusii Exotica*, p. 24. - - - - which in Crete is

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called *ascolymbros*, and in Lemnos *scombrouolo*, that is *scombri carduus*. This thistle abounds with a milky juice, like succory, has a yellow flower, and is excellent eating; so that I know no root cultivated in gardens which can be compared in taste to the *ascolymbros*, the parsnip not even excepted Page 31.

[*] Theophrast. Hist. plant. p. 620. The figure which Stapel gives, p. 621, is not of the *scolymus hispanicus*, but of *scolymus maculatus*. It is taken from Clusius, who has also a figure of the former.

[†] I considered the heads of these poor Greeks as so many living inscriptions, which preserve to us the names mentioned by Dioscorides and Theophrastus. Though liable to different variations, they will, doubtless, be more lasting than the hardest marble, because they are every day renewed, whereas marble is effaced or destroyed. Inscriptions of this kind will preserve, therefore, to future ages the names of several plants known to those skilful Greeks who lived in happier and more learned times. *Voyage du Levant*, i. p. 34. Compare with the above what Haller says in his *Biblioth. botan.* i. p. 28.

Greek and Roman authors have not given us such descriptions of natural objects as are sufficient to enable us to ascertain exactly what they are, we suppose that they have been known under different names, and a variety of characteristics are drawn together to enable us to determine them. What, for example, we find respecting the *cinara* is too little to give a just idea of the plant; we read somewhat more of the *carduus;* and because between these there seems to be an affinity, it is concluded that the *cinara* and the *carduus* were the same plant; and every thing told us respecting both of them is thrown into one. Some even go further, and add what they find under a third or a fourth name. It is indeed true, that many natural objects have had several names, and the species may sometimes be rightly guessed: but conjecture ought never to be admitted unless the identity can be fully established; else one may form such a monstrous production as Horace has delineated, when he says,

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I wish commentators would follow the example of our naturalists, who consider a plant as a distinct species until it has been proved, on sure grounds, that it is nothing else than a variety of a plant already characterized. I should not therefore affirm, that the *cinara* and the *carduus* are the same, were I not able to produce the following incontestable proofs in support of my assertion.

In the first place, the Latins, Palladius and Pliny, give us the same account of the *carduus* that Columella and the Greeks do of the *cinara*. The former lost its prickles through cultivation;* its flowers were also of a purple colour;† it was propagated by seed and by shoots;‡ it required frequent watering;§ and it was remarked that it throve better when the earth was mixed with ashes.‖ Had not the *carduus* and the *cinara* been the same, Palladius and Pliny would have mentioned the latter; for we cannot suppose that they otherwise would have omitted a plant that formed a dish so much esteemed and so well known among their countrymen. The latter claims to himself the merit of having passed over no one that was held in estimation. In the second place, Virgil has translated the word *cynaros* in a part of Sophocles now lost, by *carduus*;[*] thirdly, Athenæus says expressly, that the *cinara* was by the Latins named *cardus* and *carduus*; [†] and, lastly, the old glossaries explain *cinara* by *carduus*, as we are told by Salmasius. On these grounds, therefore, I am of opinion that the *cinara* and the *carduus* were the same.

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* Palladius, iv. 9. p. 934, and lib. xi. Octob. p. 987. In the first-mentioned place he gives the same direction for preventing prickles, as that quoted respecting the *cinara*. "Si acumina seminum confringas, spinis carebunt."

† Florem purpureum mittit inter medios aculeos, celeriter canescentem et abeuntem cum aura. "The wind easily carries away the withered flowers on account of their woolly nature." *Plin.* lib. xx. cap. 23.

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§ Pallad. p. 934, Rigentur, si æstus intervenit.

‖ Pallad. xi. Octob. xi. p. 987: Cinerem sæpe sub hieme diebus siccis, fimumque miscebimus. *Columella*, lib. xi. cap. 3, speaking of *cinara*, says, Multo cinere stercorabimus; id enim genus stercoris huic oleri videtur aptissimum. The same thing is said by the Greeks.

We are informed by Apicius [‡] and Pliny [§] in what manner the *carduus* was dressed by the ancient cooks. The latter gives directions for pickling it in vinegar; but neither of them tells us what part of it was eaten. Lister thinks that Apicius speaks of the tops of the young shoots, which, as far as I know, are parts of the artichoke never eaten at present. It is, however, worthy of remark, that the tops (*turiones*) of certain kinds of the thistle species of plants, and among these the common burr,* are, in some countries, dressed and eaten like asparagus. It is not improbable also that Pliny and Apicius may have meant the ribs of the leaves; though none of the ancients has taught us the art of binding up, covering with earth, and blanching the *cinara* or *carduus*. This, perhaps, was a new invention of the gardeners; and the cooks may have had other methods of rendering the ribs of the leaves tender and eatable. Had they meant the bottom of the calyx, they would not have omitted to give a circumstantial account of the preparation, previous to its being pickled.

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[*] Κυναρος ακανθα παντα πληθυει γυην.
Cinara spinosa toto inhorret vomere.
Sophocles, in Phœnice.

- - - - - - - Segnisque horreret in arvis
Carduus.
Virgil. Georg. i. 50.

See Salmas. ad Solin. p. 161 and 162.

[†] Athen. Deipnos. at the end of the second book, p. 70. Salmasius, in his Remarks on Solinus, p. 159, is of opinion that Athenæus wrote καρδον, not καρδυον; and the Latins not *carduus*, but *cardus*.

[‡] Apic. de arte coquin. lib. iii. cap. 19.

[§] Cardui condiuntur aceto melle diluto, addita laseris radice et cumini, ne quis dies sine carduo sit. *Plin.* lib. xix. cap. 8.

The *scolymus* is by Pliny and Theophrastus reckoned to belong to the genus of the thistles. The former says, that, like most others of the same kind, the seeds were covered by a sort of wool (*pappus*).† It had a high stem, surrounded with leaves,‡ which were prickly, but which ceased to sting when the plant withered.* It flowered the whole summer through, and had often flowers and ripe seed at the same time; which is the case also with our artichoke plants.† The calyx of the *scolymus* was not prickly;‡ the root was thick, black, and sweet, and contained a milky juice. It was eaten both raw and cooked; and Theophrastus observes, as something very remarkable, that when the plant was in flower, or, as others explain the words, when it had finished blowing, it was most palatable. What renders this circumstance singular is, that most milky roots, used for food, lose their milk and become unfit to be eaten as soon as they have blown. This is the case with the goat's beard, which is eatable only the first year.

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* *Arctium lappa*, an indigenous weed, difficult to be rooted out. Elsholz, in his *Gartenbau*, quarto edition, of 1684, speaking of the Spanish cardoons, says, The strong stem of the large burr, *lappa major*, C. B. may be dressed in the same manner, and is not much different in taste. Haller, in *Hist. plant.* i. p. 70, observes, Radices edules sunt, sapore cynaræ. See also *Laurembergii Horticultura*, p. 190; *Kulms Reise*, iii. p. 318; Thomas Moufet's Health's improvement. Lond. 1746. 8vo. p. 217.

† Theophrast. Histor. plant. lib. vi. cap. 4. where σκολυμος is translated by *carduus*: γηρασκων δε το ανθος συναπαππουται, senescens flos in lanuginem pappum vocatam convertitur.

‡ Dioscor. lib. iii. cap. 16.

The *scolymus*, however, is not the only plant which forms an exception; for the garden scorzonera retains its milk, and continues eatable after it has bloomed, and as long as it has milk it may be used. According to Theophrastus and Pliny, the roots of the *scolymus* are eatable. On the other hand, Dioscorides says, that the roots were not eaten, but the young leaves only: as he informs us, however, that they were dressed like asparagus, it would appear that he meant the young shoots.[*] Theophrastus expressly tells us, that, besides the roots, the flowers [†] also were used as food; and he calls that which was eatable the pulpy part. We have, therefore, full proof that the ancients ate the tops of some plants, in the same manner as we eat our artichokes.

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* Aculei arescente folio desinunt pungere. *Plin.* lib. xxi. cap. 16.

† Mirum quod sine intervallo tota æstate aliud floret in eo genere, aliud concipit, aliud parturit. *Plin.* lib. c. Theophrastus says the same, p. 613.

‡ Theophrastus: ἡ δε κυησις ουκ ακανθωδης, αλλα προμηκης αυτου. Conceptus non spinosus, sed oblongus. But Dioscorides says, κεφαλη ακανθωδης, capitulum spinosum. This contradiction, and other small variations, have induced some to consider the *scolymus* of Theophrastus, and that of Dioscorides, as two different plants.

It may, however, be asked, what kind of a plant was the *scolymus?*—That it was different from the *cinara* is undoubtedly certain; for Dioscorides [‡] expressly distinguishes them; nor was it the eatable *carduus*, for Pliny compares it with the *carduus*, [§] and says that it was characterized from the latter by having roots fit to be eaten. [||] Stapel is of opinion that the *scolymus* is our artichoke; but this seems to me improbable, for the leaves and roots of the latter are not sweet, but harsh and bitter, and the calyx is prickly, which was not the case in the *scolymus* of Theophrastus. Besides, I find nothing in the whole description of the *scolymus* or in the accounts given us by the ancients of the *cinara* and *carduus*, that can be applied to our artichoke alone, and not to any other plant. It may be here replied, that it would be very difficult to ascertain plants from the names of the ancients, were such strong proofs required, because they had not the art of separating the different genera correctly, and of assigning to each certain characterizing marks. This I allow; and for that reason it is impossible to elucidate properly the Greek and Latin names of plants; but, in my opinion, it is better to confess this impossibility, than to deceive oneself with distant probabilities. Let the genus be ascertained when one cannot ascertain the species; let the order to which the plant belongs be determined when one cannot determine the genus; or, at least, let the class be assigned when there is sufficient authority to do so. The *cinara*, *carduus*, and *scolymus* were, therefore, species of the thistle, of which the roots and young shoots, and also the bottom of the calyx of the last, were eaten. Were I appointed, or condemned, to form a new Latin dictionary, I should explain the article *scolymus* in the following manner: *Planta composita, capitata. Caulis longus, obsitus foliis spinosis. Radix carnosa, lactescens, nigra, dulcis, edulis. Calix squamis inermibus, disco carnoso, ante efflorescentiam eduli. Semina paposa. Turiones edules.* This description, short as it is, contains every thing that the ancients have said in order to characterise that plant. It can, indeed, be understood only by those who are acquainted with the terms of botany; but what follows will require no explanation, or defining of botanical names.

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[*] Ἡ δε ποα αρτιφυης ουσα, λαχανευεται ἑφθη ὡσπερ ασπαραγος. Herba vero recens nata, si asparagi modo elixetur, oleris vicem subit. *Dioscor*. iii. 16.

[†] Ἡ δε του ογκου κυησις σαρκωδης και εδωδιμος. Pars crassior carnosa, ciboque idonea.

[‡] Dioscor. lib. iii. cap. 10, where he says of a plant that its leaves were like those of the σκολυμος, and its stem like that of the κιναρα.

[§] Lib. xxi. cap. 16.

[||] Scolymus carduorum generis ab iis distat, quod radix ejus vescendo est decocta. Pag. 250.

Should it be said that the *scolymus* must be our artichoke, because no other plant of the thistle kind is known the bottom of the calyx of which is eatable, I would in answer observe:—First, other species may have been known in ancient times, which, perhaps, have been disused and forgotten since the pleasanter and more delicious artichoke became known. It is certain that many old plants have in this manner been banished from our gardens by the introduction of new ones. Thus have common alexanders [*] fallen into neglect since celery was made known by the Italians, about the end of the 17th century; and so at present has the cultivation of winter-cresses,[†] bulbous-rooted chærophyllum,[‡] rocket,[§] and others, been abandoned since better vegetables have been obtained to supply their place. Secondly, it is certain that, even at present, the bottom of the calyx of some others of the thistle-kind, besides the genus of the artichoke, is eaten; such as the cotton-thistle,[‖]

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[*] Smyrnium olusatrum. See my Grundsätze der Teutschen landwirthschaft, p. 117.

[†] Erysimum barbarea.

[‡] Chærophyllum bulbosum.

[§] Brassica eruca.

[‖] Onopordum acanthium. See Halleri Hist. plant. i. p. 69. Linnæi Amoen. academ. vol. vi. p. 194.

and the carline thistle,[*] without mentioning the sun-flower, which has been brought to us in modern times from South America.

Without engaging to examine all the hypotheses of commentators and ancient botanists on this subject, I shall take notice of one conjecture which, upon mature consideration, appears to have some probability. Clusius [†] is of opinion that the plant called by the botanists of the 17th century *carduus chrysanthemus*, and by those of the present age *scolymus Hispanicus*, the golden thistle, is the *scolymus* of Theophrastus; because its leaves, beset with white prickles, and its pulpy, sweet, milky roots are eaten, and excel in taste all roots whatever, even those of skirret; and because it was collected and sold in Spain, Italy, and Greece. But what has principally attracted my attention to this conjecture, is the account of Bellon [‡] that this plant in Crete or Candia is called still by the Greeks there *ascolymbros*. This name seems to have arisen from *scolymos*; and besides Stapel[*] found in an old glossary the word *ascolymbros*. I am likewise convinced that, as Tournefort[†] has said, the botany of the ancients would be much illustrated and rendered more certain, were the names used by the modern Greeks known. It is certain that many old names have been preserved till the present time with little variation; but, nevertheless, I can as little admit the assertion of Clusius as that of Stapel; for *scolymus hispanicus* has neither the bottom of the calyx pulpy, nor wool adhering to the seeds, like the *scolymus* of Theophrastus; and the young roots only can be eaten, because, like those

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[*] Carlina acaulis. Haller. l. c. p. 80. Lin. l. c.

[†] Clusii Rariorum plantarum historiæ, lib. iv. p. 153.

[‡] In Crete there is a kind of prickly plant, which, in the common Greek idiom, is generally called *ascolimbros*. The ancient Latins called it also by a Greek name, *glycyrrhizon*, though different from *glycyrrhiza* (liquorice). It grows every where spontaneously, has a yellow flower, and abounds with a milky juice. The roots and leaves are usually eaten before it shoots up into a stem. We saw it exposed to sale, with other herbs, in the market-place of Ravenna, and at Ancona, where the women, who were digging it up, gave it the name of *riuci*. We saw it gathered also in the Campagna di Roma, where the inhabitants called it *spinaborda*. This is the plant which by the modern Greeks is named *ascolimbrous*. *Bellonii Observationes*, lib. i. cap. 18, added to *Clusii Exotica*, p. 24. - - - - which in Crete is

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called *ascolymbros*, and in Lemnos *scombrouolo*, that is *scombri carduus*. This thistle abounds with a milky juice, like succory, has a yellow flower, and is excellent eating; so that I know no root cultivated in gardens which can be compared in taste to the *ascolymbros*, the parsnip not even excepted Page 31.

[*] Theophrast. Hist. plant. p. 620. The figure which Stapel gives, p. 621, is not of the *scolymus hispanicus*, but of *scolymus maculatus*. It is taken from Clusius, who has also a figure of the former.

[†] I considered the heads of these poor Greeks as so many living inscriptions, which preserve to us the names mentioned by Dioscorides and Theophrastus. Though liable to different variations, they will, doubtless, be more lasting than the hardest marble, because they are every day renewed, whereas marble is effaced or destroyed. Inscriptions of this kind will preserve, therefore, to future ages the names of several plants known to those skilful Greeks who lived in happier and more learned times. *Voyage du Levant*, i. p. 34. Compare with the above what Haller says in his *Biblioth. botan.* i. p. 28.

of most plants of the genus of the thistle; they lose their milk when the flower is in bloom; lastly, the leaves retain their power of pricking, even after they have become withered.

The fourth name which, with any kind of probability, has been translated by the word artichoke is *cactus*. This plant, which, in the time of Theophrastus and Pliny, grew only in Sicily, and not in Greece, had broad prickly leaves;* the flower was filled with a kind of wool, which, when eaten inadvertently, was pernicious;† the calyx was prickly; and, besides a long stem, it shot forth branches which crept along the ground,‡ and which, when the outer rind had been peeled off, were eaten either fresh, or pickled in salt water.[*] The bottom of the calyx of this plant was likewise used, after it had been freed from its seeds and woolly substance.[†] It had a great resemblance to the pith of the palm-tree.[‡]

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* Cactos quoque in Sicilia tantum nascitur, suæ proprietatis et ipse; in terra serpunt caules, a radice emissi, lato folio et spinoso. Caules vocant cactos, nec fastidiunt in cibis, inveteratos quoque. Unum caulem rectum habent, quem vocant pternica, ejusdem suavitatis sed vetustatis impatientem. Semen ei lanuginis, quam pappon vocant; quo detracto et cortice, teneritas similis cerebro palmæ est; vocant ascalian. *Plin.* lib. xxi. cap. 16. See *Theoph.* lib. vi. cap. 4. Theocritus, Idyll. x. 4. mentions a lamb wounded in the foot by a *cactus*: τας τον ποδα κακτος ετυψεν. The scholiast upon this observes, κακτος δε ειδος ακανθης. Tertullian names this plant among prickly weeds, together with the *rubus*, in the end of the second chapter of that unintelligible book *De Pallio*. De la Cerda, in his excellent edition of *Opera Tertulliani*, Lutetiæ Paris. 1624. 2 vol. fol. i. p. 13, reads *carecto* instead of *cucto*; but Saumaise, in his edition of that work, p. 172, has sufficiently vindicated the latter. *Antigonus Caryst.* chap. 8, calls κακτος a Sicilian kind of thistle.

† Dioscorid. Alexipharm. cap. 33.

‡ Αφιησι γαρ ευθυς απο της ριζης καυλους επιγειους. Statim ab radice caules repentes in terram mittit. *Theoph.* p. 613. Such plants with creeping branches he calls, lib. vii. c. 8. p. 819, επιγειοκαυλα.

That the *cactus* was different from the *scolymus* we are expressly told by Theophrastus; and Pliny also distinguishes them both from each other and from the *carduus*. Athenæus[§] is the only author who says that the *cactus* and the *cinara* were the same; but he gives no other proof than a very simple etymology. It must, therefore, be admitted that the *cactus* was a species of the thistle kind entirely different from any of the former.

I think I have proved, therefore, that the Greeks and the Romans used the pulpy bottom of the calyx, and the tenderest stalks and young shoots of some plants reckoned to belong to the thistle kind, in the same manner as we use artichokes and cardoons; and that the latter were unknown to them. It appears to me probable that the use of these plants, at least in Italy, and Europe in general, was in the course of time laid aside and forgotten, and that the artichoke, when it was first brought to Italy from the Levant, was considered as a new species of food. It is undoubtedly certain that our artichoke was first known in that country in the 15th century. Hermolaus Barbarus, who died in 1494, relates that this plant was first seen at Venice in a garden in 1473, at which time it was very scarce.[*] About the year 1466, one of the family of Strozza brought the first artichokes to Florence from Naples.[†] Politian, in a letter in which he describes the dishes he found at a grand entertainment in Italy in 1488, among these mentions artichokes.[*] They were introduced into France in the beginning of the sixteenth century;[†] and into England in the reign of Henry the Eighth.[‡]

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[*] The creeping branches were in particular called *cacti*, the upright stem *pternix*.

[†] Theophrastus calls the bottom of the calyx περικαρπιον, a word which in botany still retains the same meaning as that author explains it, lib. i. c. 3 and 4. See Bodæus's Observations, p. 10 and 628. Theophrastus, however, says likewise, that the same part of the *cactus* was called also σκαλια; from which is derived the *ascalia* of Pliny. Galen calls it σπονδυλον.

[‡] Εμφερες τω του φοινικος εγκεφαλω. Simile cerebro palmæ. *Theoph.* This term is explained by Pliny, lib. xiii. c. 4: Dulcis medulla palmarum in cacumine, quod cerebrum appellant.

[§] Athen. Deipnos. at the end of the second book, p. 70. He gives every thing to be found in Theophrastus; but either the author or some of his transcribers have so confused what he says, that it is almost unintelligible.

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[*] Nondum irrepsit hoc ferculum Venetiis, una tantum ejus planta Mauriano vico cernitur in hortis Barbaricis. *Herm. Barbar. ad Dioscor.* iii. 15. See Dioscoridis libri viii, Ruellio interprete, cum H. Barbari corollariis et Vergilii annotationibus. Argentorati 1529. fol. p. 157.

[†] Philippus Matthæi Simonis Strozæ bene et ipse de Florentina republica meritus, magnificæque Strozarum domus præ cæteris ædificator, carduum sativum circa annum 1466 ex Neapoli primamque ficum, gentile vulgo appellatam, Florentiæ advexit. *Manni de Florentinis inventis commentarium*, p. 34. *Matthiolus*, in his Observations on Dioscorides, iii. 14, says, Cardui nostrates in Hetruriam ex Neapoli allati fuerunt; Neapolim vero (ut audio) ex Sicilia.

Respecting the origin of the name various conjectures have been formed, none of which, in my opinion, are founded even on probability. Hermolaus Barbarus, Henry Stephen, Ruellius, Heresbach, and others think that *artichoke*, or *artichaut* as it is called by the French, and *arciocco* by the Italians, is derived from the Greek word *coccalus*, which signifies a fir-cone, with the Arabic article *al* prefixed, from which was formed *alcocalon*, and afterwards the name now used.[§] This etymology is contradicted by Saumaise,[||] who denies that *coccalus* had ever that signification. He remarks also that artichokes were by the Arabs called *harsaf*, *harxaf*, or *harchiaf*; and he seems not disinclined to derive the name from these appellations.[*] Grotius, Bodæus, and some others, derive it from a Greek word,[†] which occurs in Alexander Trallianus,[‡] and which is supposed to signify our plant; but that word is to be found in this author alone, and in him only once; so that the idea of these critics appears to me very improbable. Frisch affirms, in his dictionary, that our modern name is formed from *carduus* and *scolymus* united. Ihre[§] considers the first part of the name as the German word *erde* (the earth), because it is often pronounced *erdschoke*; but I rather think that the Germans changed the foreign word *arti* into the word *erde*, which was known to them, in the same manner as of *tartuffolo* we have made *erdtoffeln*;[||] besides, Ihre leaves the latter part unexplained.[¶]

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[*] Carduus et scolymon, sive cynaram potius appellare convenit. *Politiani Opera.* Lugduni 1533. 8vo. p. 444.

[†] Hoc memoria nostra ferculum Gallis irrepsit. Nunc fere plurimæ hortorum areæ hac stirpe pubescunt, ut nec jam sine cibo hoc, nisi tempus anni neget, opipara vel aditialis ulla sit cœna. *Ruellius de natura stirpium.* Basiliæ 1543. fol. p. 485.

[‡] The passage from Hakluyt, vol. ii. p. 164, which proves this, may be found in the *Biographia Britannica*, vol. iv. p. 2462, and in Anderson's History of commerce.

[§] Ligures arcoccum vocant, quasi alcoccalon; ut prima ejus verbi syllaba pro articulo sit, quem Mauritani omnibus fere vocibus præponunt. *Hermolaus Barbarus*, in his Observations on Dioscorides.

[||] Salmas. ad Solin. p. 160.

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[*] Ab illo Arabico *harsciaf* videndum an descenderit vulgaris appellatio cardi qui nobis artichan, aliis hercoccus. Pronuntiatione melius apparet similitudo. *Salmasii Exercitat. de homonymis hyles iatricæ.* Trajecti ad Rhenum 1689. fol. p. 77. It is remarked in Golius's Dictionary, p. 597, that this word signifies also the scales of a fish, and the strong scales of the calyx of the plant may have given rise to the name.

[†] The Greek word is αρτυτικη.

[‡] Lib. vii. cap. 3. De curatione retentricis facultatis. In the Latin translation in *Stephani Medicæ artis princip.* p. 221, the word *artytica* is retained.

[§] Ihre, Glossarium Suiogothicum. Upsaliæ 1769. fol. i. p. 411.

[||] Potatoes.

[¶] A variety of derivations may be found collected in Dictionnaire étymologique de la langue Françoise, par M. Menage. See the last edition by Jault, Paris 1750, 2 vol. fol. i. p. 96.

In the 17th century the plant was often called *Welsch distel* (Italian thistle), because the seeds were procured from Italy, and also *strobeldorn,*[*] a word undoubtedly derived from *strobilus.*

Were the original country of the artichoke really known, the etymology of the name, perhaps, might be easily explained. Linnæus says that it grew wild in Narbonne, Italy, and Sicily, and the cardoons in Crete; but, in my opinion, the information respecting the latter has been taken only from the above-quoted passage of Bellon, which is improperly supposed to allude to the artichoke. As far as I know, it was not found upon that island either by Tournefort or any other traveller. Garidel,[†] however, mentions the artichoke under the name given it by Baubin, *cinara sylvestris latifolia,* among the plants growing wild in Provence; but later authors assure us that they sought for it there in vain.[‡] I shall here remark that the artichoke, as Saumaise[§] tells us, is certainly known in Persia; but Tavernier says expressly that it was carried thither, like asparagus, and other European vegetables of the kitchen-garden, by the Carmelite and other monks; and that it was only in latter times, that it became common.*

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[*] Heresbach de re rustica, lib. ii. p. 251.

[†] Histoire des plantes qui naissent aux environs d'Aix. Par Garidel. A Aix 1715. fol. p. 111.

[‡] Je l'ai cherché vainement dans les campagnes sans l'y trouver. Quoique cette contrée éprove peu de froid, il y gêle cependant, et son pied périt tout entier. Ce n'est pas la marche des plantes vivaces dans leur pays natal. *Cours complet d'agriculture,* par l'Abbe Rozier, vol. ii. p. 14.

[§] De homonymis, p. 78.

SAW-MILLS.

In early periods, the trunks of trees were split with wedges into as many and as thin pieces as possible;† and if it was necessary to have them still thinner, they were hewn on both sides to the proper size. This simple and wasteful manner of making boards has been still continued to the present time. Peter the Great of Russia endeavoured to put a stop to it by forbidding hewn deals to be transported on the river Neva. The saw, however, though so convenient and beneficial, has not been able to banish entirely the practice of

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[*] See his Travels. Geneva 1681, fol. p. 164.

[†] Nam primi cuneis scindebant fissile lignum.

Virgil. Georg. lib. i. v. 144.

Pontoppidan says, "Before the middle of the sixteenth century all trunks were hewn and split with the ax into two planks; whereas at present they would give seven or eight boards. This is still done in some places where there are no saw-mills in the neighbourhood; especially at Sudenoer and Amte Nordland, where a great many boats and sloops are built of such hewn boards, which are twice as strong as those sawn; but they consume too many trunks." See *Natürliche historie von Norwegen.* Copenhagen 1753, 2 vol. 8vo. i. p. 244, splitting timber used in building, or in making furniture and utensils, for I do not speak here of fire-wood; and, indeed, it must be allowed that this method is attended with peculiar advantages, which that of sawing can never possess. The wood-splitters perform their work more expeditiously than sawyers, and split timber is much stronger than that which has been sawn; for the fissure follows the grain of the wood, and leaves it whole; whereas the saw, which proceeds in the line chalked out for it, divides the fibres, and by these means lessens its cohesion and solidity. Split timber, indeed, turns out often crooked and warped; but in many purposes to which it is applied this is not prejudicial; and such faults may sometimes be amended. As the fibres, however, retain their natural length and direction, thin boards, particularly, can be bent much better. This is a great advantage in making pipe-staves, or sieve-frames, which require still more art, and in forming various implements of the like kind.

Our common saw, which needs only to be guided by the hand of the workman, however simple it may be, was not known to the inhabitants of America when they had the misfortune to be subdued by the Europeans.* The inventor of this instrument has by the Greeks been inserted in their mythology, with a place in which, among their gods, they honoured the greatest benefactors of the earliest ages. By some he is called Talus, and by others Perdix. Pliny[*] alone ascribes the invention to Dædalus; but Hardouin, in the passage where he does so, chooses to read Talus rather than Dædalus. In my opinion, Pliny may have committed an error, as well as any of the moderns; and as one writer, at present, misleads another, Seneca,[†] who gives the same inventor, may have fallen into a mistake by copying Pliny. Diodorus Siculus,[‡] Apollodorus,[§] and others name the inventor Talus. He was the son of Dædalus' sister; and was by his mother placed under the tuition of her brother, to be instructed in his art. Having once found the jaw-bone of a snake, he employed it to cut through a small piece of wood; and by these means was induced to form a like instrument of iron, that is, to make a saw. This invention, which greatly facilitates labour, excited the envy of his master, and instigated him to put Talus to death privately. We are told, that being asked by some one, when he was burying the body, what he was depositing in the earth, he replied, A serpent. This suspicious answer discovered the murder; and thus, adds the historian, a snake was the cause of the invention, of the murder, and of its being found out.[*]

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* Histoire des Incas, de Garcilasso de la Vega, traduite par J. Baudoin. Amsterd. 1715, 8vo. ii. p. 61, 62.

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[*] Fabricam materiariam invenit Dædalus, et in ea serram. *Lib.* vii. 1. cap. 56.

[†] Quomodo oro te convenit, ut Diogenem mireris et Dædalum? Uter ex his sapiens tibi videtur, qui serram commentus est; an ille qui - - - - - - *Epist.* 90.

[‡] *Σιαγονι περιτυχων οφεως και ταυτη ξυλιφιον μικρον διαπρισας, εμιμησατο την τραχυτητα των οδοντων. Διοπερ κατασκευασαμενος εκ σιδηρου πριονα, και δια τουτου πριζων την εν τοις εργοις ξυλινην ὑλην, εδοξεν ευχρηστον ἑυρηκεναι μεγα προς την τεκτονικην τεχνην.* Dioscor. Sicul. lib. iv. cap. 78.

[§] Apollodori Biblioth. lib. iii. cap. 16. edit. Heynii. i. p. 282: *σιαγονα γαρ οφεως ἑυρων, ξυλὸν λεπτον επρισε.* Serpentis malam nactus, lignum tenue secuit. The name Ταλως, Talus, is by Pausanias, lib. i. cap. 21, improperly written Καλως. See Heyne's annotations on the passage above quoted, and *Auctores mythographi Latini*, ed. Van Staveren, Lugd. Bat. 1742, 4to. p. 102.

Hyginus,[†] Servius,[‡] Fulgentius,[§] Lactantius Placidus,[‖] Isidorus,[¶] and others call the inventor Perdix. That he was the son of a sister of

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[*] Those who are desirous of seeing the whole account may consult Diodorus, or Banier's Mythology.

[†] Dædalus Perdicem sororis suæ filium propter artificii invidiam, quod is primum serram invenerat, summo tecto dejecit. *Hygin. Fab.* 39. Dædalus Perdicem, sororis suæ filium, propter artificii invidiam occidit. *Fab.* 244. Perdix, Dædali sororis filius, serram ex piscis spina reperit. *Fab.* 274.

[‡] Ad Georg. i. 143.

[§] Mytholog. lib. iii. 2. p. 708, ed. Van Staveren: Perdix primus serram invenit.

[‖] Dædalus in Siciliam, sepulto filio, profugit. Cujus casum Perdix Calai filius, Atheniensis, pro gaudio tulit. *Lactautii Placidi Argumenta metamorphoseon Ovidii*, which may be found in the above quoted *Mythology*, and in Burmann's edition of Ovid, lib. viii. fab. 3.

[¶] Serræ circinique usum Perdices quidem adolescens invenit, quem puerum Dædalus, frater matris suæ, studiis perdocendum acceperat. Cujus pueri tantum ingenium fertur, ut dum materiæ divi-

Dædalus they all agree; but they differ respecting the name of his parents. The mother, by Fulgentius, is called Polycastes, but without any proof; and Lactantius gives to the father the name of Calaus. In Apollodorus, however, the mother of Talus is called Perdix; and the same name is given by Tzetzes to the mother of the inventor, whose name Talus he changes into Attalus.* Perdix, we are told, did not employ for a saw the jaw-bone of a snake, like Talus, but the back-bone of a fish; and this is confirmed by Ovid,† who, nevertheless, is silent respecting the name of the inventor.

What may be meant by *spina piscis* it is perhaps difficult to conjecture; but I can by no means make *spina dorsi* of it, as Dion. Salvagnius has done, in his observations on the passage quoted from Ovid's Ibis. The small bones which project from the spine of a fish (*apophyses processus*) have some similitude to a saw; but it would be hardly possible to saw through with them small

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dendæ compendium quæreret, spinam piscis imitatus de ferro laminam exasperans dentium mordacitate armavit, quam serram artifices nuncupant. *Isidori Orig.* lib. xix. cap. 19.

* Chiliad. i. 493.

† Ille etiam medio spinas in pisce notatas
Traxit in exemplum: ferroque incidit acuto
Perpetuos dentes, et serræ reperit usum.
Ovidii Metamorph. lib. viii. 244.

The following line from the Ibis, ver. 500, alludes to the same circumstance:

Ut cui causa necis serra reperta fuit.

pieces of wood. These bones are too long, as well as too far distant from each other; and the joints of the back-bone are liable to be dislocated by the smallest force. I am not acquainted with the spine of any fish which would be sufficiently strong for that purpose. The jaw-bone of a fish furnished with teeth would be more proper; but the words *spina in medio pisce* prevent us from adopting that alteration. I should be inclined rather to explain this difficulty by the bone which projects from the snout of the saw-fish, called by the Romans *serra*, and by the Greeks *pristis*. That bone, indeed, might not be altogether unfit for such an use: the teeth are strongly united to the broad bone in the middle, and are capable of resisting a great force; but they are placed at rather too great a distance. The old inhabitants of Madeira, however, we are told, really used this bone instead of a saw.*—That Talus found the jaw-bone of a snake with teeth like a saw is extremely probable, for there are many snakes which have teeth of that kind.

The saws of the Grecian carpenters had the same form, and were made in the like ingenious manner as ours are at present. This is fully shown by a painting still preserved among the antiquities of Herculaneum.* Two genii are represented at the end of a bench, which consists of a long table that rests upon two four-footed stools.† The piece of wood which is to be sawn through is secured by cramps. The saw with which the genii are at work has a perfect resemblance to our frame-saw. It consists of a square frame, having in the middle a blade, the teeth of which stand perpendicular to the plane of the frame. The piece of wood which is to be sawn extends beyond the end of the bench, and one of the workmen appears standing and the other sitting on the ground. The arms, in which the blade is fastened, have the same form as that given to them at present. In the bench are seen holes, in which the cramps that hold the timber are stuck. They are shaped like the figure seven; and the ends of them reach below the boards that form the top of it. The French call a cramp of this kind *un valet*. ‡

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* See Cadomosto's Voyage to Africa, in *Novus Orbis*, cap. 6. This account is not so ridiculous as that of Olaus Magnus, who says that the saw-fish can with his snout bore through a ship.

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* Rappresenta l'altra pittura due Genii, ch' esercitano l'arte de' falegnami: son da osservarsi nella bottega gli arredi, la sega, e 'l pancone col ferro uncinato per tenervi ferme le tavole da lavorarsi. Sotto al pancone evvi il martello, e una cassetta, forse per riporvi dentro gl'istromenti dell' arte, come appunto soglion praticare i nostri legnajuoli. Affissa al muro si vede una mensula con sopra un vase, forse con olio, per ungere i ferri. *Le Pitture antiche d'Ercolani*, tomo i. Napoli 1757, fol. tav. 34. p. 178.

† Almost in the same manner as in *L'art du Menuisier, par Roubo*. par. 1. tab. 5. fig. 9.

‡ That cramps or hold-fasts are still formed in the same manner as those seen in the ancient painting found at Herculaneum, parti-

Montfaucon[*] also has given the representation of two ancient saws taken from Gruter. One of them seems to be only the blade of a saw without any frame; but the other figure I consider as a cross-cut saw; and I think I can distinguish all the parts, though it is imperfectly delineated. One may however perceive both the handles between which the blade is fastened; the wooden bar that binds them together, though the blade is delineated too near it; and about the middle of this bar, the piece of wood that tightens the cord which keeps the handles as well as the whole instrument firm. Saws which were not placed in a frame, but fastened to a handle, are thus described by Palladius:[†] Serrulæ manubriatæ minores majoresque ad mensuram cubiti, quibus facile est, quod per serram fieri non potest, resecando trunco arboris, aut vitis interseri.

The most beneficial and ingenious improvement of this instrument was, without doubt, the invention of saw-mills, which are driven either by water

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cularly when fine inlaid works are made, is proved by the figure in *Roubo, l'Art du Menuisier* p. 1. p. 56. tab. xi. fig. 4. and tab. xii. fig. 15.

[*] L'antiquité expliquée et representée en figures. Tome troisieme. Paris 1719, fol. par. 2. pl. 189, pag. 341.

[†] Pallad. de re rust. lib. i. tit. 43.—Cicero in his oration for Cluentius, chap. lxiv. speaks of an ingenious saw, with which a thief sawed out the bottom of a chest.—Cum exsectio illa fundi in armario animadverteretur, quærebant homines, quonam modo fieri potuisset. Quidam ex amicis Sassiæ recordatus est, se nuper in auctione quadam vidisse in rebus minutis aduncam ex omni parte dentium et tortuosam venire serrulam, qua illud potuisse ita circumsecari videretur.

or by the wind. Mills of the first kind were erected so early as the fourth century, in Germany, on the small river Roer or Ruer:[*] for though Ausonius speaks properly of water-mills for cutting stone, and not timber, it cannot be doubted that these were invented later than mills for manufacturing deals, or that both kinds were erected at the same time. The art, however, of cutting marble with a saw is very old. Pliny[†] conjectures that it was invented in Caria; at least he knew no building incrusted with marble of greater antiquity than the palace of King Mausolus, at Halicarnassus. This edifice is celebrated by Vitruvius,[‡] for the beauty of its marble; and Pliny gives an account of the different kinds of sand used for cutting it; for it is the sand properly, says he, and not the saw, which produces that effect. The latter presses down the former, and rubs it against the marble; and the coarser the sand is, the longer will be the time required to polish the marble which has been cut by it. Stones of the soap-rock kind, which are indeed softer than marble, and which would require less force than wood, were sawn at that period:* but it appears that the far harder glassy kinds of stone were sawn then also; for we are told of the discovery of a building which was encrusted with cut agate, carnelian, lapis-lazuli, and amethysts.† I have, however, found no account in any of the Greek or Roman writers of a mill for sawing wood; and as the writers of modern times speak of saw-mills as new and uncommon, it would seem that the oldest construction of them has been forgotten, or that some important improvement has made them appear entirely new.

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[*] - - - - - - - Ille (Erubrus)
Præcipiti torquens cerealia saxa rotatu,
Stridentesque trahens per lævia marmora serras,
Audit perpetuos ripa ex utraque tumultus.
Ansonii Mosella, v. 361.

[†] Secandi marmor in crustas nescio an Cariæ fuerit inventum. Antiquissima, quod equidem inveniam, Halicarnassi Mausoli domus Proconnesio marmore exculta est, lateritiis parietibus. Is obiit Olympiadis cvi. anno secundo, urbis Romæ anno cccciiii. - - - - - - Sed quisquis primum invenit secare, luxuriamque dividere, importuni ingenii fuit. Arena hoc fit, et ferro videtur fieri, serra in prætenui linea premente arenas, versandoque tractu ipso secante - - - - - Jam quidem quacunque arena secare e fluviis omnibus fraus artificum ausa est; quod dispendium admodum pauci intelligunt. Crassior enim arena laxioribus segmentis terit, et plus erodit marmoris, majusque opus scabritia polituræ relinquit. *Plin.* lib. xxxvi. cap. 6.

[‡] Item Halicarnassi, potentissimi regis Mausoli domus cum Proconnesio marmore omnia haberet ornata, parietes habet latere structos, qui ad hoc tempus egregiam præstant firmitatem, ita tectoriis operibus expoliti, ut vitri perluciditatem videantur habere. *Vitruv.* lib. ii. cap. 8.

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* In Belgica provincia candidum lapidem serra, qua lignum, faciliusque etiam, secant, ad tegularem et imbricum vicem. *Plin.* lib. xxxvi. cap. 22.

† As a proof of this I can quote only the following passage, in Jannon de S. Laurent's treatise on the cut stones of the ancieuts, in *Saggi di dissertazioni lette nella Academia Etrusca di Cortona,* tom. vi. Roma, 1751, 4to. p. 56. L'arte di segare i marmi facilmente fece arrivare gli antichi a segare pure le pietre più dure; lo che, senza andar a ricercar altro, trovo dimostrato da quello edificio antico scoperto nel tempo di Flaminio Vacca, il cui pavimento era composto di lastre di agata e di carniola, ed altro di lapislazzali ed amatiste veduto da Santi Bartoli. Ved. *Flam. Vac Mem. di var. antich.* n. 101. I conclude from *Fabricii Bibliograph. antiquar.* p. 27, that this book of Vacca was never printed.

Becher says, with his usual confidence, that saw-mills were invented in the seventeenth century.* Though this is certainly false, I did not expect to find that there were saw-mills in the neighbourhood of Augsburg, so early as the year 1337, as Mr. Stetten† has discovered by the town-books of that place. I shall here insert his own words, in answer to a request I made that he would be so kind as to communicate to me all the information he knew on that subject. "You are desirous of reading that passage in our town-books, where saw-mills are first mentioned; but it is of very little importance. There is to be found only under the year 1338 the name of a burgher called *Giss Saegemuller;* and though it may be objected that one cannot from the name infer the existence of the employment, I am of a different opinion; especially as I have lately been able to obtain a proof much more to be depended on. In the Surveyors' book, which I have often before quoted, and which, perhaps, for many centuries has not been seen or consulted by any one, I find under the year 1322, and several times afterwards, sums disbursed under the following title: *Molitori dicto Hanrey pro asseribus et swaertlingis.* Schwartlings, among us, are the outside deals of the trunk, which, in other places, are called *Schwarten.* This word, therefore, makes the existence of a saw-mill pretty certain. As a confirmation of this idea, we have still a mill of that kind which is, at present, called the Hanrey-mill; and the stream which supplies it with water is called the Hanrey-brook. Since the earliest ages, the ground on which this mill, and the colour, stamping, and oil-mills in the neighbourhood, are built, was the property of the hospital of the Holy Ghost. By that hospital it was given as a life-rent to a rich burgher named Erlinger, but returned again in 1417 by his daughter Anna Bittingerin, who had, above and under the Hanrey-mill, two other saw-mills, which still exist, and for which, in virtue of an order of council of that year, she entered into a contract with the hospital in regard to the water and mill-dams."—There were saw-mills, therefore, at Augsburg, so early as 1322. This appears to be highly probable also from the circumstance, that such mills occur very often in the following century in many other countries.

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* Saw-mills are useful machines, first introduced in this century; and I do not know any one who can properly be called the real inventor. *Närrische weisheit.* Frankf. 1683, 12mo. p. 78.

† In that excellent work, *Kunst-und-handwerks geschichte der Stadt Augsburg,* 1779, 8vo. p. 141.

When the Infant Henry sent settlers to the island of Madeira, which was discovered in 1420, and caused European fruits of every kind to be carried thither, he ordered saw-mills to be erected also, for the purpose of sawing into deals the various species of excellent timber with which the island abounded, and which were afterwards transported to Portugal.[*] About the year 1427 the city of Breslau had a saw-mill which produced a yearly rent of three marks;[†] and in 1490 the magistrates of Erfurt purchased a forest, in which they caused a saw-mill to be erected, and they rented another mill in the neighbourhood besides.[‡] Norway, which is covered with forests, had the first saw-mill about the year 1530. This mode of manufacturing timber was called the new art; and because the exportation of deals was by these means increased, that circumstance gave occasion to the deal-tythe, introduced by Christian III in the year 1545.[§] Soon after the celebrated Henry Ranzau caused the first mill of this kind to be built in Holstein.* In 1552 there was a saw-mill at Joachimsthal, which, as we are told, belonged to Jacob Geusen, mathematician.† In the year 1555 the bishop of Ely, ambassador from Mary queen of England to the court of Rome, having seen a saw-mill in the neighbourhood of Lyons, the writer of his travels thought it worthy of a particular description.‡ In the sixteenth century, however, there were mills with different saw-blades, by which a plank could be cut into several deals at the same

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[*] This we are told by Abraham Peritsol, the Jew, in *Itinera mundi*, printed with the learned annotations of Thomas Hyde, in *Ugolino, Thesaur. antiquitatum sacrarum*, vol. vii. Venetiis 1747, fol. p. 103. Relictæ sunt ibi arbores magnæ de lignis Gopher et lignis citrorum, ut ex eorum lignis uterentur ad conficiendum asseres et tabulas pulcerrimas et cistas, artificio serræ quæ ligna secat per vires cursus octo fluviorum minorum, quæ, inquam, ligna secant motu serræ; et ex istis tabulis et asseribus et plancis conficiunt cistas, et vasa pulcra, quæ per viam mercaturæ advehuntur ad serviendum majori parti civitatum regni Portugalliæ, et particulariter Lisbonæ—Peritsol wrote before the year 1547.

[†] Von Breslau dokumentirte geschichte und beschreibung. Breslau 1781. 8vo. vol. ii. part 2, p. 409.

[‡] Von Falkensteins Historie von Erfurth. Erfurth 1739. 4to. p. 424.

[§] Nicolaus Cragius, in his *Historia regis Christiani III.* Hafniæ 1737, fol. p. 293, speaking of the year 1545, says: In Norvegia hoc amplius novum institutum, ut asserum, qui ex silvis regiis serris reciderentur, decimum quemque, qui eo commodo fruerentur fisco in-

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ferrent. Ea tum *nova ars* dicebatur, in Norvegiam, ubi suppetebat semper abunde materia, demum Friderici regis tempore introducta. Ac quia inde aucto studio et industria hominum multum emolumenti incolis accessit, æquum visum est, aliquam etiam utilitatem redundare ad fiscum, quippe cujus erant silvæ quæ in hunc usum cædebantur.—See also *Pontoppidans Natürliche historie von Norwegen,* erster theil, Kopenhag. 1753, 8vo. p. 244; *Von Holbergs Beschreibung der Stadt Bergen,* Kopenhag. 1753, 8vo. p. 42.

* Allgemeine Welthistorie, xxxiii. p. 227.

† So says Mathesius *in der Joachimsthalischen Chronik.*

‡ The account of this journey may be found in *Miscellaneous State Papers, from* 1501 *to* 1726, London 1778, 4to. i. p. 71: "The saw-mill is driven with an upright wheel; and the water that maketh it go, is gathered whole into a narrow trough, which delivereth the same water to the wheels. This wheel hath a piece of timber put to the axle-tree end, like the handle of a broch, and fastened to the end of the saw, which being turned with the force of the water, hoisteth up and down the saw, that it continually eateth in, and the handle of the same is kept in a rigall of wood from swerving. Also the timber lieth as it were upon a ladder, which is brought by little and little to the saw with another vice."—This passage was pointed out to me by Professor Sprengel of Halle.

time. Pighius saw one of these, in 1575, on the Danube, near Ratisbon, when he accompanied Charles, prince of Juliers and Cleves, on his travels.* It may here be asked whether the Dutch had such mills first, as is commonly believed.† The first saw-mill was erected in Holland at Saardam, in the year 1596; and the invention of it is ascribed to Cornelis Cornelissen; ‡ but he is as little the inventor as the mathematician of Joachimsthal. Perhaps he was the first person who built a saw-mill at that place, which is a village of great trade, and has still a great many saw-mills, though the number of them is becoming daily less; for within the last thirty years a hundred have been given up.§ The first mill of this kind in

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* Lignariæ moletrinæ tunc ostendebant, ut vasti ponderis trabes, arbores etiam immensæ, sua sponte ex undis exurgentes in tabulata ac pontes, sese stridentibus subsilientium, ac multiplicium serratum dentibus ingerunt, atque in plures uno tractu brevi temporis spatio tabulas partiuntur. *Hercules Prodicus.* Coloniæ 1609, 8vo. p. 95.

† Leupolds und Beyers *Theatrum machinarum molarium.* Leipzig 1735, fol. p. 114. I shall here take occasion to remark, that in the sixteenth century there were boring-mills driven by water. Felix Fabri, in his *Historia Suevorum*, p. 81, says, that there were such mills at Ulm: Ibi trabes magnæ perforantur aquæ motu.

‡ De zaag-moolens zyn door eenen Cornelis Cornelissen van Uytgeest in den jare 1592 uytgevonden, die de eerste in den jare 1596 op Saanerdam heeft gebracht, de welke om desselfs gedaante het Juffertjen wierdt genaamt, waar van de standt-plaats noch in gedachtenis wordt gehouden. *De koophandel van Amsterdam.* Amsterdam 1727, vol. ii. p. 583.

§ La richesse de la Hollande. A Londres 1778, 4to. i. p. 259.

Sweden was erected in the year 1653.* At present, that kingdom possesses the largest perhaps ever constructed in Europe, where a water-wheel, twelve feet broad, drives at the same time seventy-two saws.†

In England saw-mills had at first the same fate that printing had in Turkey, the ribbon-loom in the dominions of the Church, and the crane at Strasburgh. When attempts were made to introduce them they were violently opposed, because it was apprehended that the sawyers would be deprived by them of their means of getting a subsistence. For this reason, it was found necessary to abandon a saw-mill erected by a Dutchman near London,‡ in 1663; and in the year 1700, when one Houghton laid before the nation the advantages of such a mill, he expressed his apprehension that it might excite the rage of the populace.§ What he dreaded was actually the case in 1767 or 1768, when an opulent timber-merchant, by the desire and approbation of the Society of Arts, caused a saw-mill, driven by wind, to be erected at Limehouse under the direction of James Stansfield, who had learned, in Holland and Norway, the art of constructing and managing machines of that kind. A mob assembled, and pulled the mill to pieces; but the damage was made good by the nation, and some of the rioters were punished. A new mill was afterwards erected, which was suffered to work without molestation, and which gave occasion to the erection of others.* It appears, however, that this was not the only mill of the kind then in Britain; for one driven also by wind had been built at Leith, in Scotland, some years before.†

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* We are told so by Joh. Clason in his academical discourse *om Sweriges handel omskiften* 1751.

† See Professor Busch, Reise durch Schweden, p. 14.

‡ Anderson's History of commerce.

§ Husbandry and trade improved, by John Houghton. London 1727, 8vo. iii. p. 47.

STAMPED PAPER.

PAPER stamped with a certain mark by Government, and which in many countries must be used for all judicial acts, public deeds, and private contracts, in order to give them validity, is one of those numerous modes of taxation invented after the other means of raising money for the service of states, or rather of their rulers, became exhausted. It is not of great antiquity; for before the invention of our paper it would not have been a very productive source of finance. When parchment and other substances employed for writing on were dear; when greater simplicity of manners produced more honesty and more confidence among mankind; and when tallies supplied the place of notes, bonds, and receipts, writings of that kind were very little in use.

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* Memoirs of agriculture and other œconomical arts, by Robert Dossie. London 1768, 8vo. i. p. 123. Of Stansfield's mill, on which he made some improvements, a description and figure may be seen in the Advancement of arts, manufactures, and commerce, by William Bailey. London 1772, 4to. i. p. 231.

† Anderson ut supra.

De Basville or Baville, however, in his *Mémoires pour servir à l'histoire de Languedoc*, affirms that stamped paper was introduced so early as the year 537, by the emperor Justinian. This book, written by the author, intendant of that province in 1697, for the use of the duke of Burgundy, was printed, in óctavo, at Marseilles in 1734, and not at Amsterdam, as announced in the title; but it was carefully suppressed by the Government, and on that account is very scarce even in France.* I have never seen it; but I know the author's ideas respecting stamped paper, from an extract in *Varietés historiques, physiques, et litteraires*, printed at Paris in the year 1752.† The author of this work supports the opinion of his countryman: but it is undoubtedly false; for the law quoted as a proof requires only that documents should be written on such paper as had marked at the top (which was called the protocoll) the name of the intendant of the finances, and the time when the paper was made; and this regulation was established merely with a view to prevent the forging and altering of acts or deeds.* A kind of stamped paper therefore was brought into use, though different from what we have at present, the principal intention of which is not to render writings more secure, but by imposing a certain duty on the stamps, proportioned to the importance of the purpose it is employed for, to make a considerable addition to the public revenue.† The stamps serve as a receipt to show that the tax has been paid; and, though many law papers must be stamped, that burthen has tended as little to prevent law-suits as the stamping of cards has to lessen gaming: though some think differently. In both too much is risked and too much expected for taxes to deter mankind from engaging in either.

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* An account of this book may be found in *Anecdotes secret. sur divers sujets de litterat.* 1734, p. 573. and in the preface to *Etat de la France, de M. de Boulainvilliers*, fol. p. 12.

† An extract from it is inserted also in the Paris edition of the *Encyclopédie*, vol. xi. p. 862.

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* Illud quoque præsenti adjicimus legi, ut tabelliones non in alia charta pura scribant documenta, nisi in illa quæ in initio (quod vocatur protocollum) per tempora gloriosissimi comitis sacrarum nostrarum largitionum habeat appellationem, et tempus quo charta facta est, et quæcunque in talibus scribuntur; et ut protocollum non incidant, sed insertum relinquant; novimus enim multas falsitates ex talibus chartis ostensas et prius et nunc; ideoque, licet aliqua sit charta (nam et hoc sancimus) habens protocollum non ita conscriptum, sed aliam quandam scripturam gerens, neque illam suscipiant, tanquam adulteram, et ad talia non opportunam, sed in sola tali charta qualem dudum diximus documenta scribant. Hæc itaque quæ de qualitate talium chartarum a nobis decreta sunt, et de incisione eorum quæ vocantur protocolla, valere in hac felicissima solum civitate volumus, ubi plurima quidem contrahentium multitudo, multa quoque chartarum abundantia est, et licet legali modo interesse negotiis, et non dare occasionem quibusdam falsitatem committere, cui se obnoxios existere demonstrabunt qui præter hæc aliquid agere præsumpserint. *Novell.* coll. iv. tit. 23. cap. 2. nov. 44.

† Such is the idea of Stryk in *Continuat. altera usus moderni pandectarum,* lib. xxii. tit. 4. p. 856: Chartæ signatæ hodiernæ est longe alius finis, et potissimum ad augendum fiscum inventa est.

If in this historical research, we look only to the antiquity of stamping, we shall find that both the Greeks and the Romans had soldiers marked in that manner; and, if we may be allowed to bring together things so different, we might include under the like head those run-away slaves who were marked by being branded; but I allude here only to the stamped paper now in use, which was certainly invented in Holland, a country where every necessary of life is subjected to taxation. The States of the United Provinces having promised a reward to any one who should invent a new impost, that might at the same time bear light on the people and be productive to the government, some person proposed that of *bezegelde brieven*, or stamped paper, which was approved; and which Boxhorn, to whom we are indebted for this information, considers as a very proper tax. He is of opinion also that it might with great advantage be adopted in other countries;* and this was really the case soon after his death, which happened in 1653.

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* The States of Holland having laid sufficiently heavy duties on merchandise of every kind, and these not being equal to the expenditure, which was daily increasing, began to think of imposing new

Stamped paper was introduced in Holland on the 13th of August 1624, by an ordinance which represented the necessity and great benefit of this new tax. Among other things advanced in its favour, it was said, that it would tend to lessen lawsuits, and, on that account, would soon recommend itself to neighbouring nations. What we are told, therefore, by the author of an extract in *Variétés*

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ones. For that purpose they issued an edict, inviting the ingenious to turn their thoughts towards that subject, and offering a very ample reward to whoever should invent a new tax, that might be as little burdensome as possible, and yet productive to the republic. Some shrewd, deep-thinking person, at length, devised one on stamped paper (called *de impost van bezegelde brieven*), to be paid for all paper impressed with the seal of the States. The inventor proposed, that it should be enacted by public authority, that no petitions from the states, or from the magistrates of any city or district, or any public bodies, should be received; that no documents should be admitted in courts of justice; that no receipts should be legal, and that no acts signed by notaries, secretaries, or other persons in office, and, in short, no contracts should be valid, except such as were written upon paper to which the seal of the States had been affixed, in the manner above mentioned. It was proposed, also, that this paper should be sold by the clerks of the different towns, and courts, at the following rate: paper impressed with the great seal of the States for sixpence, and that with the less seal for twopence per sheet: for according to the importance of the business it was necessary that the great or less seal should be used - - - - The States approved this plan, and it was immediately put in execution. *Boxhornii Disquisitiones politic.* casus 59. These *Disquisitiones politicæ* were printed by the author only for the use of his scholars, and published, at first, without his name. They are to be found, however, in *Boxhornii Varii tractatus politici.* Amstelodami 1663, *historiques*, before quoted, that stamped paper began to be used in Holland and Spain so early as the year 1555, is certainly false. The Spaniards may, indeed, have been the first people who followed the example of the Dutch; for the author above mentioned asserts, that he saw an act, executed by a notary at Brussels, in 1668, which was written on stamped paper.

This tax was introduced in the electorate of Saxony by an ordinance of the 22d of March 1682; and into that of Brandenburg on the 15th of July

12mo. In this collection there is also *Boxhornii Reip. Batuviæ brevis et accurata descriptio*, in the eighth chapter of which the author gives the following account of the origin of stamped paper: "A very ingenious method has lately been invented of raising large sums of money for the use of the republic. As there are many rich people who have entrusted a considerable share of their property to the public treasury, the interest of which they receive annually on giving receipts; as many law-suits are carried on which are generally entered into by the wealthy, and which cannot be brought to a conclusion until a variety of instruments, as they are called, have been executed on each side; and as, on account of the flourishing state of trade, many contracts are made, which, for the sake of security, must be mutually signed, the States thought proper to enact, by a public edict, that no receipts, law-papers, contracts, or instruments of the like kind, should be legal or valid, unless written on paper impressed with the great or small seal of the States. A price was also fixed on the paper, to be paid by those who had occasion for it; so that a sheet which before could be purchased for a halfpenny, was raised to several pence; and it is incredible how great a revenue these sheets bring to the public, by so many of them being used. The poor, however, and those of small fortune, feel little of this burden, as the rich principally are concerned in the transactions above mentioned."

the same year.* Bartholdus however says, but without producing any proof,† that stamped paper was used before that period in Denmark, Florence, and Silesia. In Hanover it was first introduced, as I think, on the 20th of February 1709.

INSURANCE.

INSURANCE, that excellent establishment by which losses that would entirely ruin a merchant, being divided among a company, are rendered supportable, and almost imperceptible; by which undertakings too great for one person are easily accomplished, and by which commodities brought from the most distant regions are made cheaper,‡ appears not to have been known to the Romans, however near they may have come to the invention of it. If we examine closely the information from which some endeavour to prove the contrary, it will be found that it is far from sufficient to support their opinion.

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* Mylii Corpus constitut. March. p. iv. sect. 5. cap. 3. Von Dreyhaupts Beschreibung des Saal-Kreises, im auszuge, ii. p. 591. G. F. Mullers Stempel-recht. Halle 1778. 8vo. p. 9.

† Fr. Jac. Bartholdi Diss. de charta signata; resp. P. Kolhart. Francof. ad Viadr. 1690. cap. 2, § 16, p. 36.

‡ As the Turks are unacquainted with insurance, they do not lend money but at the rate of fifteen or twenty per cent. When they lend to merchants who trade by sea, they charge thirty per cent. See *Remarques d'un voyageur moderne au Levant*. Amsterdam 1773. 8vo.

Puffendorf,[*] Barbeyrac,[†] Loccenius,[‡] Kulpis,[§] and others, ground their assertions on a passage of Livy,[‖] who says, that when the Roman army in Spain was distressed for provisions, clothing, and other necessaries, a company engaged to convey to them every thing they stood in need of, under this stipulation, *ut quæ in naves imposuissent, ab hostium tempestatisque vi publico periculo essent;* that is, that the State should make good their loss, in case their vessels should be shipwrecked by storms, or be taken by the enemy; and we are told that these terms were agreed to. This was, undoubtedly, a promise of indemnification, but by no means an insurance, in which it is always necessary that a premium should be given. On occasions of this kind, however, acts of fraud were practised, like those committed at present, to the prejudice of insurers. Shipwrecks were pretended to have happened which never took place; and old shattered vessels, freighted with articles of little value, were purposely sunk, and the crew saved in boats; and large sums were then demanded, as a reimbursement for the loss.*

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[*] Puffendorfii de jure naturæ et gentium libri, cum annotationibus Hertii. Francofurti ad Mœn. 1706. 4to. p. 725.

[†] Le droit de la nature. A Basle 1732. 2 vol. 4to. ii. p. 92.

[‡] Loccenius de jure maritimo. Holmiæ 1650. 12mo. p. 151.

[§] J. G. de Kulpis, Collegium Grotianum, edit. quinta Francofurti et Lipsiæ 1722, 4to. p. 84. Compare, Schele, Dissert. de instrumento assecurationis, vulgo *polizza*, præs. Werlhofio. Helmstadii 1707.

[‖] Livius, lib. xxiii. cap. 44.

Little more is proved by a passage of Suetonius,† which Kulpis and others consider as affording an instance of insurance. That author tells us, that the emperor Claudius promised to indemnify merchants for their losses, if their ships should perish by storms at sea. This passage Anderson‡ must not have read; else he would not have said that Suetonius ascribed the invention of insurance to Claudius; and Kulpis seems not to have searched Valerius Maximus, otherwise he would not have quoted the fifth chapter of the sixth book, which contains nothing that can be applied to insurance.

In Simon's edition of *Grotius de jure belli et pacis*§ a passage is quoted from Cicero's epistles‖ as an instance of insurance among the Romans, which seems to be more probable. Cicero says he hopes to find at Laodicea security, by means of which he can remit the money of the republic, without being exposed to any danger on its passage. The word *prædes* may here signify insurers; but, in my opinion, this quotation ought rather to be classed among those which have been collected by Ayrer, as the first traces of bills of exchange.*

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* Liv. lib. xxv. cap. 3.

† Nam et negotiatoribus certa lucra proposuit, suscepto in se damno, si cui quid per tempestates accidisset. Lib. v. cap. 18. Langenbec in his *Anmerkungen über das Hamburgische Schiff-und-seerecht*, p. 370, is of opinion that no traces of insurance are to be found either in Livy or Suetonius.

‡ History of commerce.

§ Jenæ 1673. 4to. p. 375.

‖ Laodiceæ me prædes accepturum arbitror omnis pecuniæ publicæ, ut et mihi et populo cautum sit sine vecturæ periculo. *Epist. ad famil.* ii. ep. 17.

Those remains of the ancient laws which, according to Kulpis and others, allude to insurance, concern bottomry (*fœnus nauticum*) only; and that this is much older than insurance has been already fully proved by Stypman.†

Molynes,‡ Anderson, and others affirm, that insurance is mentioned in the marine laws of the Isle of Oleron. This island, which lies opposite to the mouth of the Charente, on the coast of France, was much celebrated in the eleventh, twelfth, and following centuries, on account of its trade.§ It belonged then to the duke of Aquitaine, and came to the crown of England by the marriage of Eleonora, daughter of the last duke, with Henry II. Under Eleonora were framed in the island those laws so well known by the names

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* Ayreri Diatribe de cambialis instituti vestigiis apud Romanos, added to Uhle's edition of *Heineccii Elementa juris cambialis*.

† Stypmanni Tractatus de jure maritimo et nautico. Gryphiswaldiæ 1652. par. iv. p. 19.

‡ Consuetudo vel lex mercatoria, or the ancient law-merchant, by Gerard Molynes. London 1656. fol. p. 105.

§ This island may be found in the map entitled *Insulæ divi Martini et Uliarus*, Amstelod. apud Joan. Jansson; and in Seutter's map, *Les environs de Rochelle*.

Roole d'Oleron, *Roole des jugemens d'Oleron*, that, like the laws of the Rhodians, they were used also by foreigners. These laws were afterwards enlarged and improved by Richard I, Eleonora's son; at least we are assured so by the French historians: but the English ascribe them to Richard alone. In order to determine the period when they were framed, I shall only observe that Eleonora died in the year 1202, and Richard in 1199; and Anderson, therefore, not without probability, places the origin of them in the year 1194. A copy of these laws, printed at Rouen, is still preserved, in which it is said that they were first drawn up in 1266. This, however, the French and the English declare to be false.[*] They are written in French, that is, in the old Gascon dialect. I am acquainted with them from the following scarce book, the author of which, in the preface, calls himself Cleirac: *Us et coutumes de la mer*;[†] but I find no traces in them of insurance. Even Cleirac himself, who has given an excellent explanation of the laws of

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[*] Seldeni Mare clausum, seu de dominio maris. Londini 1636. 8vo. p. 428.

[†] Bourdeaux 1661. 4to. p. 1. Respecting this book, and all the old maritime laws, there is an excellent account in *Brevis introductio in notitiam legum nauticarum, et scriptorum juris reique maritimæ*. Lubecæ 1713, 8vo. Struve says, in his *Bibliotheca juris selecta*, p. 119, that the learned author was a Dr. Andreas Lang, at Lubec. It is much to be wished that some one would cause the laws of Oleron to be again printed, illustrated and compared with those which at present resemble them.

Oleron, seems not to have found any; for where he relates every thing he knew respecting the history of it, he ascribes this invention, and also that of bills of exchange, to the Jews, who made use of it when they were expelled from France. According to Cleirac, insurance was long detested by the Christians, who at that time considered it as a sin to take interest; and the use of it, as well as of bills of exchange, was first made common by the Guelphs and Ghibelines. Of this pretended service of the Jews, in regard to insurance, I know no proof.

The celebrated maritime laws of the city of Wisby, in the island of Gothland,* whether of later date, as the French assert, or older, which is more probable, than those of Oleron, are equally silent with respect to insurance. These laws were not written originally in Swedish, as l'Estocq † says, but in the Low-German. The translation into High-German by Marquard ‡ is incorrect, and the French one of Cleirac § is too free and too much abridged. The Dutch translation published at Amsterdam is the completest. ‖

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* Lange, p. 35.

† Auszug der historie des algemeinen und Preussischen see-rechts. Konigsberg 1747, 4to. p. 32.

‡ De jure mercatorum et commerciorum.

§ Page 165.

‖ Entitled, 'T boek der zee-rechten, inhoudende dat hoochste ende oudste Godtlandtsche water-recht. Amsterdam 1664, 4to. p. 2.

Insurance was, undoubtedly, not known at the time when the later Hanseatic maritime laws were framed, else it would have been mentioned in them. Of these laws there are various editions. One of those most used is that by Kericke, which is inserted also in *Heineccii Scriptorum de jure nautico et maritimo fasciculus.* Cleirac has given a French translation of them.

As little respecting insurance is to be found in *Il consolato del mare.* These maritime laws, highly worthy of notice, were originally written in the Catalonian dialect; and it seems very probable that they were drawn up at Barcelona. A part of them appears to have been framed in the eleventh, but the greater part in the thirteenth century; for the book itself proves, in more than one place, that they are not all of the same antiquity. The most correct edition is that published at Leyden in 1704.* Those writers who have pretended that insurance is mentioned in these Catalonian maritime laws have, perhaps, been led into this error, because, in an appendix to some of the common editions, there is a short account of insurance as once practised at Barcelona.[*] As I have never seen this small treatise, I do not know whether it contains any thing respecting the history of it. The oldest laws and regulations concerning insurance, with which I am at present acquainted, are the following.

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* The title runs thus: *Il consolato del mare, nel quale si comprendono tutti gli statuti et ordini, disposti da gli antichi per ogni cosa di mercantia et di navigare.* Leyden 1704. 4to. To the other editions mentioned by Lange, p. 50, may be added that printed in *J. L. M. de Casaregis Discursus legales de commercio.* Florentiæ 1719. fol. It is the original, with Italian notes, but it is somewhat different from that of Westerveen.

On the 28th of January 1523, five persons appointed for that purpose drew up at Florence some articles which are still employed on the exchange at Leghorn. These important regulations, together with the prescribed form of policies, which may be considered as the oldest,[†] have been inserted, in Italian and German, by Magens, in his Treatise on insurance, average and bottomry,[‡] published at Hamburgh in 1753. I should have been glad to have found in Italian authors some information respecting the antiquity of these regulations,[§] a copy of which Magens says he procured from Leghorn; but I have hitherto sought for it in vain. Straccha, however, mentions a Florentine order of June the 15th, 1526, which forbids common insurance, unless the goods and commodities are specified.[*]

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[*] Lange, p. 32.

[†] In that old treatise, *Le Guidon*, inserted in Cleirac, it is remarked, chap. i. art. i. that, in old times, insurances were made without any writings: they were then called *Assecurances en confiance*; Confidential insurances.

[‡] Versuche über assecuranzen, havereyen und bodmereyen. Hamburg 1753. 4to. p. 367.

[§] I found nothing on the subject, either in *Della decima—e della mercatura de' Fiorentini, fino al secolo* xvi. Lisbona e Lucca 1765, 1766. 4 vol. 4to. which contains a variety of useful information respecting the history of the Florentine trade, or in *Mecatti, Storia chronologica della città di Firenze.* In Napoli 1775, 2 vol. 4to.

There is still preserved a short regulation of the 25th May 1537, by the emperor Charles V, respecting bills of exchange and insurance, in which the strictly fulfilling only of an agreement of insurance is commanded.

In 1549 the same emperor issued an express order, *Op 't faict van der zee-vaerdt*, in which occur some articles respecting insurance,[†] and additions were afterwards made to it in 1561.

In the year 1556, Philip II, king of Spain, gave to the Spanish merchants certain regulations respecting insurance, which are inserted by Magens, with a German translation, in his work before mentioned. They contain some forms of policies on ships going to the Indies.

On the last of October 1563, Philip II published his maritime laws, in which some forms of policies are given;[‡] but on the last of March 1568 that prince forbade the practice of insurance, on account of the bad use to which it had been often applied. This prohibition I have not been able to find. I am acquainted with it only by an order of the 20th of January 1570, in which the king expressly recalls it, because the merchants at Antwerp, both subjects and foreigners, had presented strong remonstrances against it.*

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[*] Stracchæ aliorumque juris consultorum de cambiis, sponsionibus, &c. decisiones et tractatus. Amstelodami 1669. fol. In Tractatus de assecurationibus, p. 24.

[†] It may be found in *Ordonantien ende placcaeten ghepubliceert Vlaenderen*. T'Antwerpen 1662, fol. i. p. 360.

[‡] Ordonantien ende placcaeten ii. p. 307. Groote Placaet-boeck der Vereenighde Nederlanden, i. p. 796. Magens, p. 397.

In the year 1598, the *Kamer von assurantie*, Chamber of Insurance, was established at Amsterdam. An account of the first regulations of this insurance-office may be seen in Pontanus's History of the city of Amsterdam, and in other works.†

In the year 1600, regulations respecting insurance were formed by the city of Middelburg in Zealand.‡

It appears that the first regulations respecting insurances in England, which may be seen in Anderson's History of commerce, were made in the year 1601. We find by them, that insurers had before that period conducted themselves in such a manner, that the utmost confidence was reposed in their honesty, and that on this account few or no disputes had arisen.

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* Ordonantien ende placcaeten, ut supra, p. 335. Groote Placaet-boeck, i. p. 828, and in the additions, ii. p. 2116.

† J. J. Pontani Rerum et urbis Amstelodamensium historia. Amsterdam 1611. fol. p. 255. J. le Long, Koophandel van Amsterdam. Rotterdam 1780, 3 vol. 8vo. i. p. 47. The changes which this institution afterwards underwent, with an extract from its regulations, may be seen in *La richesse de la Hollande*. A Londres 1778. 4to. i. p. 81.

‡ Groote Placaet-boeck, i. p. 867.

In the year 1604 regulations were formed respecting insurance at Rotterdam;[*] and in 1610 were drawn up those of Genoa, which Magens has inserted in his work, taken from the Latin statutes of the Republic, together with a German translation.[†]

In 1612 the Insurance Chamber at Amsterdam was established by public authority, and received several privileges.[‡]

Molynes asserts,[§] but without either proofs or probability, that the people of Antwerp were first taught insurance by the English; and says that, as the merchants assembled for transacting business in Lombard-street, so called because certain Italians from Lombardy had *lombards* there, or houses for lending money on pledges, long before the building of the Exchange, it became customary, as it was in his time (1622), to be guided in policies by what was done in Lombard-street, in London.

Guicciardini, who wrote his Account of the Netherlands in 1567, remarks, in describing Antwerp,[‖] that the merchants there were accustomed to insure their ships. Anderson says, which is very astonishing, as he thinks the invention of insurance is to be found in Suetonius, and in the laws of the Isle of Oleron, that this is the first instance of maritime insurance.

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[*] See Groote Placaet-boeck, i. p. 859.

[†] Page 503 and 512.

[‡] Groote Placaet-boeck, ut supra, p. 843.

[§] Page 105.

[‖] Guicciardini, Descrittione di tutti Paesi Bassi. In Anversa 1567. fol. p. 126.

A most useful imitation of insurance in trade is the institution of insurance-offices, to indemnify losses sustained by fire. As far as I have been able to learn, companies for that purpose were first formed towards the middle of the last century, though houses were insured by individuals much earlier. The fire-office at Paris* was established in 1745; that of the electorate of Hanover in 1750; that of Nassau-Weilburg in 1751; those of Brunswick-Wolfenbuttel and Wirtemberg† in 1753; that of Anspach in 1754; that of Baden-Durlach in 1758; that of the county of Mark in 1764; those of Saxe-Weymar and Eisenach in 1768; and that of the Society of the Clergy in the Mark of Brandenburg,‡ to insure goods and household-furniture, was established in 1769.

It is perhaps known to few, that even in the beginning of the seventeenth century, a proposal was made by some ingenious person, that all the proprietors of land should insure the houses of their subjects against fire, on their paying so much per cent. annually, according to the value of them. The author of this scheme presented it to count Anthony Gunther von Oldenburg, in the year 1609, as a means of finance not to be found in any work printed on that subject. The author in his plan said,* that "as many fires happened by which a great number of people lost their property, the count might lay before his subjects the danger of such accidents; and propose to them, that if they would, either singly or united, put a value on their houses, and for every hundred dollars valuation pay to him yearly one dollar; he, on the other hand, would engage, that in case by the will of God their houses should be reduced to ashes, the misfortunes of war excepted, he would take upon himself the loss, and pay to the sufferers as much money as might be sufficient to rebuild them; and that all persons, both natives and foreigners, who might be desirous of sharing in the benefits of this institution should not be excluded. The author was confident that, though the damage might fall heavy at first, a considerable sum would be gradually raised, from year to year; and that every one might thus insure his houses against accidents. He had no doubt that it would be fully proved, if a calculation were made of the number of houses consumed by fire, within a certain space, in the course of thirty years, that the loss would not amount, by a good deal, to the sum that would be collected in that time. He did not, however, advise that all the houses in every town should be comprehended, as the money claimed might amount to too much; but only that some and certain houses should be admitted into this association."

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* Journal œconomique, 1758. Fevr. p. 70.

† Weissers Nachricht von den gesetzen des Herzogthums Wirtemberg. Stutgart 1781. 8vo. p. 39.

‡ Krunitz, Oekonomische encyclopedie, xiii. p. 221: where an account may be found of other companies.

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* This account is taken from *J. J. Winkelmanns Oldenburgischen friedens- und der benachbarten örter kriegshandlungen*. 1671. fol. p. 67.

I shall here insert, from the same author, the count's reflections on this plan, and the conclusion which he formed. "It is to be considered," says he, "what sum every proprietor of land may with certainty raise and receive; whether the proposed plan can, to the undoubted benefit of the subjects, and the advantage of their lord, be honourably, justly, and irreproachfully instituted without tempting Providence; without incurring the censure of neighbours; and without disgracing one's name and dignity. In the next place, that this institution may not have the appearance of a scheme to bring money into the country; and still more that it may have no resemblance to a duty, tax, or impost, but rather to a free contribution, or unconstrained remuneration for being insured from danger, and by which losses being made good, houses can be sooner rebuilt, and put in their former condition." The count allowed that the object of the plan was good, considered in every point of view, and that a company composed of common individuals might be formed to insure each other's houses, and pay the losses sustained by fire: but he concluded, that, if he undertook the plan, Providence might be tempted; that his own subjects might be displeased; and that, improper ideas being formed of his conduct, he might be accused unjustly of avarice. "God," he said, "had without such means preserved and blessed, for many centuries, the ancient house of Oldenburg; and he would still be present with him, through his mercy, and protect his subjects from destructive fires." He dismissed, therefore, the ingenious author of this plan, but not without rewarding him according to his usual liberality.

ADULTERATION OF WINE.

No adulteration of any article has ever been invented so pernicious to the health, and at the same time so much practised, as that of wine with preparations of lead; and as the inventor must have been acquainted with its destructive effects, he deserves, for making it known, severer execration than Berthold Schwartz, the supposed inventor of gun-powder.

The juice of the grape, when expressed, becomes wine through the first degree of fermentation; but scarcely has that begun when it approaches the second degree, called the sour fermentation. It then loses its spirit; instead of which it becomes combined with an acid, which renders it unfit to be drunk, and of much less utility. The progress of the fermentation may be stopped by care and attention; but to bring the liquor back to its former state is impossible; for the law of corruption is a law of nature, and admits of no exception. Ingenuity, however, has invented a fraudulent method of rendering the acid in spoilt wine imperceptible; so that those who are not judges are often imposed on, and purchase sweetened vinegar instead of wine. Were no other articles used for sweetening it than honey or sugar, the adulterator would deserve no severer punishment than those who sell pinchbeck for gold; but saccharine juices can be used only when the liquor begins to turn sour; and even then in very small quantities, else it would betray the imposition by its sweetish-sour taste, and hasten that corruption which it is intended to prevent. A sweetener, therefore, has been invented much surer for the fraudulent dealer, but infinitely more destructive to the consumer; and those who employ it, undoubtedly, merit the same punishment as the most infamous poisoners.

Lead and calx of lead, dissolved in the acid which spoils wine, give it a saccharine taste not unpleasant, without any new, or at least perceptible, tint, and stop the fermentation or corruption. The wine, however, occasions, according as it is used in a great or small quantity, and according to the constitution of the consumer, a speedy or lingering death, violent colics, obstructions and other maladies; so that one may justly doubt whether, at present, Mars, Venus, or Saturn is most destructive to the human race.

The ancients, in my opinion, knew that lead rendered harsh wine milder, and preserved it from acidity, without being aware that it was poisonous. It was, therefore, long used with confidence; and when its effects were discovered they were not ascribed to the metal, but to some other cause. When more accurate observation, in modern times, fully established the noxious quality of lead, and when it began to be dreaded in wine, unprincipled dealers invented an artful method of employing it, which the law, by the severest punishment, has not been able wholly to prevent.

The Greeks and the Romans were accustomed to boil their wine over a slow fire, till only a half, third, or fourth part remained, and to mix it with bad wine in order to improve it. When, by this operation, it had lost part of its watery particles, and had been mixed with honey and spices, it acquired several names, such as *mustum*, *mulsum*, *sapa*, *carenum*, or *caroenum*, *defrutum*,* &c. Even at present the same method is pursued with sack, Spanish, Hungarian, and Italian wines. In Italy new wine, which has been thus boiled, is put into flasks, and used for salad and sauces. In Naples it is called *musto cotto*; but in Florence it still retains the name of *sapa*. Most of those authors who have described this method of boiling wine expressly say that leaden or tin vessels must be employed; because the wine, by these, is rendered more delicious and durable, as well as clearer. It is, however, certain that must and sour wine by slow boiling, for according to their directions it should not be boiled quickly, must dissolve part of these dangerous metals, otherwise the desired effect could not be produced.* Some also were accustomed to

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* Vino cognata res sapa est, musto decocto donec tertia supersit. Ex albo hoc melius. *Plin.* lib. xxiii. cap. 2. Nunc defrutum, caroenum, sapam conficies. Cum omnia uno genere conficiantur ex musto, modus his et virtutem mutabit, et nomina. Nam defrutum,

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a defervendo dictum, ubi ad spissitudinem fortiter despumaverit, effectum est. Caroenum, cum tertia perdita duæ partes remanserint. Sapa, ubi ad tertias redacta descenderit; quam tamen meliorem facient cydonia simul cocta, et igni supposita ligna ficulnea. *Palladius, Octob.* 18. edit. Gesneri, ii. p. 994.

[*] As a proof the following passages will be sufficient: Ipsa autem vasa, quibus sapa aut defrutum coquitur, plumbea potius quam ænea esse debent; nam in coctura æruginem remittunt ænea, et medicaminis saporem vitiant. *Columella de re rustica*, lib. xii. c. 20.

Musti quadrantalia viginti in aheneum aut plumbeum infundito, ignem subdito. *Cato de re rust.* cap. cv.

Cura quoque adhibenda est ut expressum mustum perenne sit, aut certe usque ad venditionem durabile; quod quemadmodum fieri debeat, et quibus condituris adjuvari, deinceps subjiciemus. Quidam partem quartam ejus musti, quod in vasa plumbea conjecerunt, nonnulli tertiam decoquunt; nec dubium, quin ad dimidium si quis add to their wine, before it was boiled, a certain quantity of sea water, which by its saline particles would necessarily accelerate the solution.*

That the acid of wine has the power of dissolving lead was not unknown to the ancients; for when the Greek and Roman wine-merchants wished to try whether their wine was spoilt, they immersed in it a plate of lead.† If the colour of the lead was changed, which undoubtedly would be the case when its surface was corroded and converted into calx, they concluded that their wine was spoilt. It cannot, however, be said that they were altogether ignorant of the dangerous effects of solutions of that metal; for Galen and other physicians often give cautions respecting white lead. Notwithstanding this, men fell upon the invention of

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excoxerit, meliorem sapam facturus sit: eoque usibus utiliorem, adeo quidem, ut etiam vice defruti, sapa, mustum, quod est ex veteribus vineis, condire possit. *Columella*, lib. xii. cap. 19.

Ipsa quoque defruta ac sapas—coqui jubent—plumbeis vasis, non æneis. *Plin.* lib. xiv. cap. 21.

Sapæ congios sex quam optime infundito in aheneum, aut in plumbeum. *Cato*, cap. cvii.

* Proofs that the ancients mixed their wine with sea-water may be found in *Pliny*, lib. xxiii. cap. 1. and lib. xiv. cap. 20. *Celsus* exclaims against it, lib. ii. cap. 25. *Dioscorides*, lib. v. cap. 7, 9, &c. p. 573. See *Petri Andreæ Matthioli Commentarii in sex libros Dioscoridis de materia medica.* Venetiis, in officina Erasmi Vincentii Valgrisii, 1553. fol.

† Vini in vitium inclinantis experimentum est laminæ plumbeæ mutatus in eo color. *Plin.* lib. xiv. cap. 20. This method of proof is given more circumstantially in *Geopon.* lib. vii. cap. 15.

conveying water for culinary purposes in leaden pipes;[*] and even at present at Amsterdam, Paris, and other places water is conveyed through lead, and collected in leaden cisterns, though that practice has, on several occasions, been attended with alarming consequences.[†] This negligence in modern times makes us not be surprised when we read that the ancients employed leaden vessels. It appears, however, that it was not merely through negligence that this practice prevailed. They were acquainted, and particularly in Pliny's time, with various processes used in regard to wine;[‡] and among these was that of boiling it with lime or gypsum;[§] and the ancient physicians, who had not the assistance of our modern chemistry, thought it more probable that their wine was rendered noxious by the addition of these earths,* than by the vessels in which it was boiled; and they were the more inclined to this opinion, as they had instances of the fatal effects produced by the use of them.† They decried them, therefore, so much, that laws were afterwards made by which they were forbidden to be used, as poisonous and destructive to the human body.

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[*] Ultima ratio est, plumbeis fistulis aquam ducere, quæ aquas noxias reddunt. Nam cerusa plumbo creatur attrito, quæ corporibus nocet humanis. *Pallad. August.* c. ii. vol. ii. p. 977.

[†] An account of experiments, made to ascertain whether water can dissolve lead, may be found in my translation of *Sage's Chemische untersuchung verschiedener mineralien*, p. 121. and in *Medical transactions published by the college of physicians in London*, vol. i. p. 291. Solution will hardly be possible as long as the water is perfectly pure; but it may easily acquire saline particles, and its power of dissolving becomes then considerable. This circumstance has not been remarked by Perrault, in his translation of Vitruvius.

[‡] Proprium inter liquores vino, mucescere, aut in acetum verti; extantque medicinæ volumina. *Plin.* lib. xiv. cap. 20. The same author relates a great many arts practised in regard to wine.

[§] Africa gypso mitigat asperitatem, nec non aliquibus sui partibus calce. *Plin.* lib. xiv. cap. 19. That this method was practised in Italy is confirmed by *Columella*, lib. xii. cap. 20. and Didymus in *Geopon.* lib. vi. cap. 18. It is mentioned also by Dioscorides and Theophrastus.

Wine which has once begun to spoil cannot be perfectly restored by lime; for it cannot bring back to it the spiritous part which it has lost, neither can it remove the acid with which it is incorporated; but it can render it imperceptible to the tongue by uniting with it, and forming an earthy salt of an almost insipid taste. This method of improving sour wine is still practised in the island of Zante,‡ in Spain,§ on the coast of Africa,‖

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* Marmore enim et gypso, aut calce condita quis non et validus expaverit! *Plin.* lib. xxiii. cap. 1.

† Exemplum illustre C. Proculeium Augusti Cæsaris familiaritate subnixum in maximo stomachi dolore, gypso poto, conscivisse sibi mortem. *Plin.* lib. xxxvi. cap. 24.

‡ The wine of the island of Zante is almost as strong as brandy. It is supposed that this proceeds from the unslaked lime which is usually mixed with it, under the pretence that it then keeps better, and is fitter to be transported by sea. *Arvieux, Nachrichten von seiner reise*, vol. iii. p. 328.

§ Christophori a Vega de arte medendi, lib. ii. cap. 2.

‖ No one sells wine at Tunis but the slaves, and this wine is not under the jurisdiction of the Tunisian government. They put lime and in many other countries. It is, however, condemned by several physicians and chemists; because obstructions and other bad effects are to be apprehended from it.* Some, on the contrary, consider it as harmless;† and I must confess that I should expect no bad consequences from such a small quantity of lime as would be necessary for that purpose. It will produce a salt which will have the same effects as that tartareous crust called wine-stone, and will act as a laxative, like the salts which our apothecaries prepare from that calcareous stone crab's-eyes, by means of vinegar or lemon-juice. The lime, which the acid of the wine cannot dissolve, will fall to the bottom as a sediment, and assist to clarify the wine. Used however in too great quantity, it may hasten the evaporation of the still remaining spiritous part, and render the wine weak: a caution which has been given to wine-merchants by Neumann.

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in it, which renders it very intoxicating. *Thevenot's Reisebeschreibung*, vol. i. p. 399, according to the edition of Franckfort, 1693, 4to.

* Mr. Cartheuser in his second *Programma de quibusdam vinorum adulterationibus, quæ additamentis mineralibus peraguntur.*

† See an essay on the corrosive quality of lime in wine in *Weber's Physikalisch-chemischen magazin*, vol. ii. p. 112, where may be found some important experiments which seem to determine this point. In *Anleitung zur verbesserung der weine in Teutschland*, Franck. and Leipsic 1775, 8vo, the moderate use of calx is recommended. In France potashes are put into wine instead of lime. See *Sage's Chemische untersuchung verschiedener mineralien*, p. 128.

Gypsum is a calcareous earth combined with the vitriolic acid; and dissolves in vinegar as well as water, like any other saline earth. Were it always fully saturated with its acid, its effects upon wine would be imperceptible: but as the most kinds of common gypsum contain abundance of loose calcareous particles, they effervesce with acids; are dissolved in part by them, and form that salt which I have before said I consider as harmless. By means of these particles gypsum improves sour wine, as well as common lime.* I took half an ounce of that gypsum which at Osterode is pounded and used as mortar, and which is hard, white, and shining, and almost of the nature of alabaster. When I had pounded it, I put it into strong vinegar in a glass vessel, and suffered it to boil for a few minutes. I then strained it through filtering-paper; and what remained, after it was washed and dried, weighed 215 grains; so that the vinegar had dissolved 25 grains, which were precipitated afterwards by an alkali. I pursued the like process with half an ounce of burnt gypsum, such as is used here for floors; and I found that two ounces of the same vinegar dissolved half a dram of it, which was somewhat more in proportion than of the former. Every one whom I caused to taste of this vinegar remarked that both had lost a considerable share of their acidity; but that the vinegar which had been boiled with burnt gypsum had lost the most. Few kinds of gypsum are completely saturated with the vitriolic acid; and at any rate we have no reason to suppose that the ancients sought perfect gypsum for their wines. This method is not yet disused. We are told by Arvieux,* that it is still employed in the island of Milo; and I shall here take occasion to observe that salt water also is added to wine there, even at present. Christopher Vega, whom I have before quoted, reproaches the Spaniards with the use of gypsum; and it has been condemned by the modern as well as the ancient physicians, such as Cartheuser.† An Englishman of the name of Hardy seems to suspect that gypsum contains lead and arsenical earth;‡ but it appears that this writer doubted whether our gypsum be the same as that of the ancients; and indeed it is necessary, before we use their information respecting natural objects, to examine carefully whether they understood by any name what we understand by it; and what they meant by gypsum has been determined neither by Stephanus, Ferber, nor Gesner. We however know this much, that the ancients burnt their gypsum, and that they formed and cast images of it.* In my opinion wine cannot be poisoned by gypsum; and wine-merchants who employ it and lime deserve no severer punishment than brewers, who, in the like manner, render sour beer fitter to be drunk and more saleable.

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* See Baumé's Experimental-chemie, vol. i. p. [illegible].

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* Vol. iv. p. 273.

† Ut supra, p. 7.

‡ The properties of lead and arsenic are well understood; but what those of the ancient gypsums were, will require an explanation; as there seems to be just reason to believe, that some of them contained a portion of metallic or arsenical earth. *A candid examination of what has been advanced on the colic of Poitou and Devonshire*, by James Hardy, London, i. 8vo. p. 84.

That the ancients were accustomed to clarify their wine with gypsum, is proved by different passages of the Greek writers on husbandry. They threw gypsum into their new wine; stirred it often round, then let it stand for some time, and, when it had settled, poured off the clear liquor.† It would, however, appear that they had remarked that gypsum caused the spirituous part to evaporate; for we read that the wine acquired by it a certain sharpness which it afterwards lost, but that the good effects of the gypsum were lasting.‡ This process in modern times has been publicly forbidden, in many countries, as in Spain§ in the year 1348.

Calcined shells were in ancient times used instead of lime.* Potters-earth was also thrown into wine, in order to clarify it by carrying the muddy particles with it to the bottom. This method I have seen employed in the breweries at Amsterdam, to purify the water. In the south of France it is used for clarifying wine-stone ley; and in my opinion it might be useful on many other occasions.†

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* Hominis imaginem gypso e facie ipsa primus omnium expressit, ceraque in eam formam gypsi infusa emendare instituit Lysistratus Sicyonius, frater Lysippi. *Plin.* lib. xxxv.

† Geopon. p. 462. 483. 494.

‡ Geopon. vii. 12. p. 483.

§ Cæsaraugustæ gypsum vino admisceri solet, ne facile acescat; hoc vero antiqua lege anni 1348 prohibetur, quæ inserta reperitur *Foris in usu non habitis*, p. 12. *Introductio in oryctographiam et zoologiam Aragoniæ*, 1784, 8vo. p. 18.

The ancients poisoned their wine with lead without knowing it; but at what period did that pernicious practice begin of employing sugar of lead and litharge? Litharge was not unknown to the ancients; for it is mentioned by Dioscorides, Aetius, and others. Sugar of lead is, indeed, more modern; but I have found no information respecting the invention of it, except that it was known to Paracelsus, who died in 1541, and who ventured to prescribe it for some disorders. It was known also to Angelus Sala, one of the most ingenious of the early chemists. In the Roman laws no particular orders occur against the adulteration or poisoning of wine; for what we read in the *Institutiones*‡ is applicable only to the spoiling of another person's wine, and thereby occasioning a loss to him; and this explanation is confirmed by the

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* Geopon. p. 486.

† Geopon. p. 486.

‡ Denique responsum est, si quis in alienum vinum aut oleum, id miscuerit, quo naturalis bonitas vini aut olei corrumperetur, ex hac parte legis Aquiliæ eum teneri. *Institut.* lib. iv. tit. 3. § 13.

Digesta.* The German prohibitions against the adulteration of wine began in the fifteenth century, and were from time to time renewed with additional severity. In that century, we find complaints against this practice with lime, sulphur, and milk; but no instance occurs of the poisoning with lead. I however conjecture that the use of litharge was introduced in the twelfth or thirteenth century; but the framers of the laws were not acquainted with the real poison; and instead of causing it to be examined by the chemists, who it must be confessed had not advanced far in their art, they contented themselves with prohibiting the use of those things which they found considered by the ancients as dangerous.

Among the oldest German prohibitions against the adulteration of wine is that of Nuremberg, in the year 1409; in which, however, there is no notice taken of litharge.† Another of the year 1475 is mentioned by Datt;‡ but some Imperial ones of an earlier period may have been lost.§ In the year

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* Cum eo plane, qui vinum spurcavit, vel effudit, vel acetum it, vel alio modo vitiavit, agi posse Aquilias, Celsus ait; quia iam effusum et acetum factum, *corrupti* appellatione continetur. *Digestor*. lib. ix. tit. 2. leg. 27. § 15. Later Jurists call the adulteration of wine *crimen stellionatus*. See *Harprecht, Resp. crimin.* par. ii. p. 237. § 7.

† Gœcking's Journal von und für Teutschland, 1784, i. p. 499.

‡ De pace imperii publica libri quinque, auctore I. P. Datt. Ulmæ 1698, fol. p. 632.

§ Goldast. Constit. imper. tom. ii. p. 114.

1487 the emperor caused an order against the adulteration of wine to be published by the governments in Swabia, Franconia, and Alsace; and this practice was a subject of deliberation at the diet of Rothenburg, the same year, and also at the diet of Worms, under Maximilian I, in 1495. At the diet of Lindau the use of sulphur was in particular prohibited, and also at Freyburg in Brisgau in 1498. In the year 1500 the same affair was discussed at Augsburg, and again at that city in 1548, under Charles V. It appears that this business was left afterwards to the care of the different princes, who from time to time issued prohibitions against so destructive a fraud.

Older and severer prohibitions are, however, to be found in other countries. By an order of William count of Hennegau, Holland, and Zeeland, of the year 1327, we find that long before that period it was customary to adulterate wine by noxious and dangerous substances. In the year 1384 the government at Brussels issued a severer order of the like kind, in which vitriol, quicksilver, and lapis calaminaris are mentioned.[*] In France we find an old *ordonnance du prevôt de Paris*, for the same purpose, dated September the 20th, and December the

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[*] W. F. Verhoevens Preischrift über den zustand der handwerke und handlung in den Niederlanden in dem 13ten und 14ten jahrhunderte, p. 96; and in Analyse du mémoire de M. Verhoeven, p. 17, Both these pieces are inserted in *Mémoires sur les questions proposées par l'académie de Bruxelles en 1777*. A Bruxelles 1778, 4to.

2d, 1371, in which no minerals are mentioned; but in that of 1696 litharge is particularly noticed.*

Conrade Celtes, who in the year 1491 was first crowned in Germany as a poet, gives in his panegyric on Nuremberg some information respecting the adulteration of wine, from which we learn that he considered it as a new invention, and ascribed it to a monk called Martin Bayr; but his expressions are so figurative, that little can be gathered from them.† We are, however, told by Zeller, that it was believed that this dangerous fraud was invented in France.* Martin Zeiler, in his Chronicle of Swabia,† says, "In the year 1453, "the citizens of Augsburg began to observe this "fraud in the wine-market; for during four years "before, Martin Bayr, at Schwarzen-Eychen in "Franconia, first taught the German tavern-keepers "and the waggoners, to preserve new wine from "becoming sour; to clarify wine by sulphur; "and likewise to counterfeit it by spices, to the "great prejudice of people's health." In this passage, there is no mention of litharge, but of other mixtures. The oldest account of the poisonous sweetening of wine is that which occurs in the French ordinance ‡ of 1696; and

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* Traité de la police, par De la Mare. Amsterdam 1729, fol. ii. p. 514.

† I wish those who adulterate wine were punished with greater severity; for this execrable fraud, as well as many more deceptions, has been invented in the present age; and a villany by which the colour, taste, smell, and substance of wine are so changed as to resemble that of another country, has been spread not only through Germany, but also through France, Hungary, and other kingdoms. It was invented, they say, by a monk named Martin Bayr, of Schwarzen-Eychen in Franconia. He undoubtedly merits eternal damnation for rendering noxious and destructive a liquor used for sacred purposes, and most agreeable to the human body; thus contaminating and debasing a gift of nature inferior to none called forth from the bosom of the earth by the influence of the solar rays; and for converting, like a cruel and sanguinary destroyer of the human race, that bestowed upon us by Nature to promote mirth and joy, and as a soother of our cares, into a poison and the cause of various distempers. But if the debasers of the current coin are punished capitally, what punishment ought to be inflicted upon the person who hath either killed or thrown into diseases all those who used wine? The former by their fraud injure a few, but the latter exposes to various dangers people of all ages, and of both sexes; occasions barrenness in women; brings on abortions and makes them miscarry; corrupts and dries up the milk of nurses; excites gouty pains in the body; causes others in the bowels and reins, than which none can be more excruciating; and produces ulcers in the in-

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testines: in short, his poison inflames, corrodes, burns, extenuates, and dries up; nor does it allay, but increase thirst; for such is the nature of sulphur, which, mixed with other noxious and poisonous things, the names of which I should be ashamed to mention, is added to wine, before it has done fermenting, in order to change its nature. This poison we have been obliged to purchase for our friends, wives, children, and selves, at a high price; as wine has been scarce for several years past; and it would seem that Nature had denied this liquor so long, out of revenge against her enemies and the destroyers of the whole human race. You ought, therefore, most prudent fathers, not only to empty their vessels, by throwing this poison into your river; but to cast alive into the flames the sellers of this wine, and thus to punish poisoning as well as robbery. *Pirkheimeri Opera*, Franck. 1610, fol. p. 136.

* Zelleri Dissert. de docimasia vini lithargyrio mangonisati. Tubingæ 1707, § 1.

† Chronicum parvum Sueviæ; oder Kleines Schwabisches zeitbuch. Ulm 1653, 4to. p. 65.

‡ De la Mare, Traité de la police, i. p. 615.

Zeller's conjecture that it was invented or first remarked in France, seems to me the more probable, as it appears that it was practised at Wurtemberg about the same period. In the year 1697 it was known there that some wine-merchants, particularly Hans George Staltser at Goppingen, used litharge of silver for refining wine, and by these means deprived many persons of life, and occasioned the loss of health to others. Staltser pleaded in excuse, that he considered the process he had employed as harmless, and that Masskosky, physician to the town of Goppingen, who was accounted a man of knowledge, had employed the same for his wine. Brugel also, physician to the town of Heidenheim, had declared that litharge was not prejudicial; and as he was a person of reputation, his opinion had tended not a little to establish the use of that practice. This report was so hurtful to the wine-trade of Wurtemberg, which at that time brought a great deal of money into the duchy from other countries, that the wine at Ulm remained unsold;, and duke Everhard Louis was obliged to cause experiments to be made to ascertain the nature of the substances mixed with it. Solomon Keysel, the duke's physician, and J. Gaspar Harlin, physician to the court, both declared that litharge was noxious, but that sulphur besprinkled with bismuth was still more so. They strongly advised, therefore, that both these substances should be forbidden to be used, under the heaviest penalties; and this prohibition was put in force with the greater severity, as some persons of the first rank had for several years before caused their spoiled and sour wine to be made sweet and clear in this manner, by a weaver of Pforzheim, who resided at Stutgart. An order was issued on the 10th of May 1697, forbidding this adulteration under pain of death and confiscation of property, as well as of being declared infamous; and the duke requested the neighbouring states, particularly Bavaria and Eychstat, to keep a more watchful eye over their wine-merchants and waggoners, by which means it was supposed all danger would be avoided.

In the following year, the city of Ulm discovered a poor man at Giengen, within its own jurisdiction, who had sweetened with litharge some sour wine purchased at Wurtemberg. He was accordingly banished from the country; and several other persons in the duchy were condemned to labour at the fortifications. This example was attended with so good an effect, that for some time adulteration was not heard of; but eight years after, John Jacob Ehrni, of Eslingen, introduced that practice again with some variation, and not only employed it himself, but induced others to follow it in several other places. Greater severity was at length exercised. Ehrni was beheaded; the possessors of adulterated wine were fined, and the wine was thrown away. After this second example, which was followed in other parts of the country, the art of adulterating wine seems to have been more carefully concealed, or to have been entirely abandoned.* But in the present century, treatises have been published on the management of wine, in which the art of improving it by litharge has been taught, as a method perfectly free from danger.†

For detecting metal in wine, the arsenical liver of sulphur is commonly employed; a solution of which is called *liquor probatorius Wurtembergicus*.‡ This appellation, in my opinion, has been given to it because it was first applied for that purpose by a public order in the duchy of Wurtemberg; though the invention is ascribed to one of the duke's physicians.§ The use of it however is not attended with certainty: not only because it precipitates all metals black without distinction, for lead is not the only one that we have reason to suspect in wine; but because this proof becomes very dubious when gypsum has been added to the wine also, for the blackness of the precipitate becomes then imperceptible by the whiteness of the earth.‖

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* Sattlers Geschichte des herzogthums Würtemberg, xii. p. 82.

† William Graham's Art of making wines from fruit, flowers, and herbs. Sixth edit. London, 8vo.

‡ Sages Chemische untersuchung verschiedener mineralien, p. 132.

§ Anleitung zur verbesserung der weine in Teutschland, p. 32.

‖ See my Physicalisch-ökonomische bibliothek, ix. p. 295. and Gmelins Einleitung in die chemie, p. 184.

The operation of fumigating wine with sulphur is performed by kindling rags of linen dipped in melted brimstone, and suffering the steam to enter a cask filled, or partly filled, with that liquor. I do not know at what period this process was invented; but it is worthy of remark, that we are told by Pliny,* that in his time some employed sulphur in the preparation of wine. On this subject he quotes Cato; but the passage to which he alludes is not to be found in the works of that author handed down to us; and the method in which it was really used is consequently unknown. Reason and experience show that the vapour of sulphur stops the fermentation so hurtful to wine, and prevents it from spoiling; and the best writers on the management of wine allow the free use of it for that purpose.† It can certainly do no injury to the health; and it was not necessary for the police, in different countries, to distribute prescriptions for employing it, to forbid it, or to limit the quantity,‡ as it produces no other effect than that of expelling the air which promotes corruption; and perhaps also the inflammable part; or, to speak more according to the new mode, of confining the fixed air which it may contain.

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* Plin. Nat. Hist. lib. xiv. cap. 20.

† See the before-quoted *Anleitung* of Mr. Sprenger, and *Wieglebs Begriff von der gährung*. Weimar 1776, 8vo. p. 57. *Mémoire sur la meilleure manière de faire et de gouverner les vins* - - - par l'abbé Rozier, 1772, 8vo.

‡ This was done at Rothenburg on the Tauber in 1497. It was ordered that half an ounce of pure sulphur should be employed for a cask containing a tun of wine; and that when wine had been once exposed to the vapour of sulphur, it should not undergo the same operation a second time.

Some wine-dealers are accustomed to sprinkle over with bismuth the rags dipped in sulphur used for fumigating wine, and this addition is a German invention.* It has been severely forbidden by express laws; and there are undoubtedly sufficient grounds for its being reprobated, because that semi-metal, which has an affinity to lead, is not only to be dreaded on its own account; but, as it is seldom pure, if used in too large a quantity, some of the metal dissolved by the sulphur may fall into the wine; and, as Pott observes, bismuth and its calx are both soluble in vinous acid. At any rate, this metallic addition is of no use in any point of view, as the most experienced dealers in wine have long since acknowledged.

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* In John Hornung's *Cista medica*, Norimbergæ 1625, there are two letters from German physicians respecting this practice. Libavius says, p. 165, Telam sulphuratam quæ bismuthum capit non laudo. Minerale hoc fumis pestilentibus arsenicalibusque est plenum - - - Fors inventor ejus putavit facere ad defecandum vinum, sicut videmus fieri musto in stanneis vasis servato; vel etiam stanno eodem liquato, et in dolia conjecto.

Doldius tells us, p. 447, Scis scopum esse præcipuum sulphuratorum duplicem, tum ad vasa tum ad vinum, potissimum tamen propter vinum excogitari a Germanis hæc mistura solet; scilicet ut vina a putredine defendantur - - Veteres id tentabant coctione. - - Compendiosius Germani in frigidis regionibus id tentarunt per telas sulphuratas, vel alia vim sulphuris habentia—Accidere potest et illa causa, quod bismuthum inter stannum et plumbum magnam habet cognationem, quæ saporem valde dulcem et saccharinum de se præbent, forte inde aliqui etiam vino aliquam gratiam conciliare se posse crediderunt.

In an old Imperial ordinance, milk also is mentioned as an article used in the adulterating of wine. This method was known to and practised by the ancient Grecians.* But in the opinion of Von Rohr milk cannot be employed for that purpose.† "One can scarcely comprehend," says he, "how the framers of laws should ever imagine that "a wine-dealer would be so simple as to adulterate "wine with milk; and those who do so, deserve "not to be punished for their folly. As they will "find no purchasers to wine adulterated by so "strange a mixture, that punishment will be sufficient." The effects of milk however may be easily comprehended. It causes the wine to throw up a scum, which carries with it every impurity; and this being taken off along with it, the wine must of course be rendered much clearer. However, though this mixture cannot be called an adulteration, it is certain that wine may be refined much better by isinglass, and that method is followed at present. ‡

I shall observe in the last place, that in the year 1472 Stum-wine, as it is called, was prohibited as a bad liquor prejudicial to the health.[*] By this term is understood wine, the fermentation of which has been checked, and which on that account continues sweet; seldom becomes clear; and, even when it clarifies, turns muddy when exposed to the air, because the fermentation, which has been stopped, again commences.[†] Wines of this kind are allowed at present. They are called *vina muta* or *suffocata*, and have a great resemblance to a sort of wine made principally at Bourdeaux, to which the French give the name of *vin en rege*.

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* Geopon. p. 486. 502.—Lemnius de miraculis occultis naturæ. Coloniæ 1581, 8vo. p. 291: Vinum corruptum ac glutinosum lacte bubulo modice salito restauratur.

† See Haushaltungs-recht. Leipsic 1716, 4to. p. 1393.

‡ Anleitung zur verbesser. der weine, p. 163 and 49.

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[*] Von Lersner, Chronica der stadt Frankfurt, ii. p. 683. Wine seasoned with mustard, and which was sold as boiled wine, was forbidden at the same time. See p. 684. In the year 1484 wine mixed with the herb mugwort was prohibited also.

[†] Anleitung, *ut supra*, p. 93, 128.

CLOCKS AND WATCHES.

A PAPER on this subject was read by professor Hamberger, in the year 1758, before the Society of Gottingen; but as the publication of the Transactions of the Society was interrûpted, it was never printed. I, however, procured the manuscript from the professor's son, Secretary Hamberger, at Gotha, and I here insert it, corrected in a few places, where necessary, but without any alteration.*

" Weidler † and Chambers ‡ are, doubtless, both mistaken when they place the invention of automatous clocks about the end of the fifteenth or beginning of the sixteenth century. The latter says, It is certain that the art of constructing clocks, such as thôse now in use, was first invented or at least revived in Germany about two hundred years ago. The same account is given by Weidler, whom Chambers perhaps copied. But,

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* The Translator has omitted the introduction, which was only a summary of what is contained in the paper itself, and also about two pages in the beginning of the paper. The Author says, that the principal writers on this subject are Alexander, a monk of the order of St. Benedict; Paute, his countryman; and our Derham.

† Histor. Astron.

‡ Encyclopædia, art. Clock.

"We find, also, that Bernardus Saccus[*] ascribes the invention of clocks to Boethius, in the fifth century; but Bernardus seems to have forgotten what he quoted a little before from Cassiodorus,[†] respecting the clock of Boethius, that it determined the hours *guttis aquarum*. It must, therefore, have been a water-clock, and not a clock moved by wheels and weights. The same Cassiodorus[‡] had provided his monks at the monastery of St. Andiol,[§] in Languedoc, with machines of the like kind: 'Horologium vobis unum,' says he, 'quod solis claritas indicet, praeparasse cognoscor; alterum vero aquatile, quod die noctuque horarum iugiter indicat quantitatem; quia frequenter nonnullis diebus solis claritas abesse cognoscitur.' We are to understand, also, as alluding to such clocks, what is said by the writer of the life of St. Leobin, bishop of Chartrain, about the year 556,[||] when he tells us: ei (Leobino) temperandi cursus horarum et vigiliarum diligentiam commissam esse.

"I come now to the seventh century. In Du Fresne's *Lexicon mediæ et infimæ Latinitatis* we find the word *Index*, which is explained to be the index or hand of a clock, or the small bell which announces the hours by its sound; and this opinion is adopted by Muratori.* Du Fresne quotes in support of his assertion a monkish work called *Regula Magistri*, the author of which is not certainly known,† but which Mabillon ‡ asserts to have been written before the year 700. The passages to which he refers are: Cum advenisse divinam horam percussus in oratorio index *monstraverit*.—Cum *sonuerit index*—and Cum ad opus divinum oratorii *index sonaverit*. § But Du Fresne might have perceived, had he quoted the whole passage from the fifty-fifth chapter, that allusion is not here made to a clock; for it is said, not merely *cum sonuerit index*, but *cum sonuerit index ab Abbate percussus*. It was a *scilla*, or *skella*, perhaps only a board; and Martene ‖ seems to understand the word *index* in the properest sense when he explains it *signum quo fratres vocabantur ad divina officia*.

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[*] Hist. Ticin. lib. vii, c. 17.

[†] Var. lib. i. in fine.

[‡] De Institut. div. litter. c. 29.

[§] In the original, *Monasterium Vivariense*. TRANS.

[||] Mabil. Annales St. O. B. sec. i. p. 123.

"That machine which was sent as a present to Charlemagne by the king of Persia, in the year 807, is supposed also to have been a clock like those used at present; and if we follow the *Chro-*

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* Muratori, Antiq. med. ævi diss. 24. p. 392.

† Lucæ Holstenii Codex regularum. Paris. 1663, p. 172.

‡ Annales.

§ Cap. 54. cap. 55. and cap. 95.

‖ Index onomasticus ad tom. iv. De antiq. eccl. rit.

nicon Turonense,[*] one may easily fall into the same opinion: 'Misit rex Persarum—horologium, in quo XII horarum cursus cognoscebantur, cymbalo ibi personante et equitibus, qui per singulas horas per fenestras exibant, et in ultima hora diei redeuntes, in regressione sua fenestras apertas claudebant.' The description of it however to be found in *Annales Francorum*,[†] ascribed to Eginhard, shows clearly that it was far different from our clocks. The author says: 'Nec non et horologium, ex aurichalco arte mechanica mirifice compositum, in quo duodecim horarum cursus ad clepsydram vertebatur, cum totidem æreis pilulis, quæ ad completionem horarum decidebant, et casu suo subjectum sibi cymbalum tinnire faciebant.'—It was evidently therefore a water-clock, furnished with some ingenious mechanism, but having nothing in common with our clocks.

"About the same period lived Pacificus, archdeacon of Verona, who is celebrated for having invented a clock.[‡] His epitaph, besides relating other services which he did, says:

Horologium nocturnum nullus ante viderat.
En invenit argumentum et primus fundaverat;
Horologioque carmen spheræ cœli optimum,
Plura alia graviaque prudens invenit.

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[*] Martene, Coll. ampl. tom. v. p. 960.

[†] Ad a. 807. Calmet. Hist. de Lorraine, vol. i. p. 582.

[‡] Onuphr. Panuvini Antiq. Veron. lib. vi. p. 153. *Scip. Maffei Degli scrittori Veronesi*, p. 32. *Muratori, Ant. Ital. med. ævi*, diss. 24. p. 392.

Scipio Maffei endeavours to prove, that we are here to understand a clock moved by wheels and weights; but, in my opinion, his arguments are extremely weak. 'This *horologium*,' says he, 'the like of which had been never seen, and which was different from a sun-dial, because it showed the hours in the night-time, could not be a clepsydra or water-clock, for clocks of that kind were not only known to the ancients, but even to the inhabitants of Italy in latter times, so that it could have been nothing but a clock like ours.' But, even if we allow, with this learned man, that water-clocks were known in Italy at that period, it cannot be denied that they were scarce, and used only by few, as may be evidently gathered from what is said of these machines by Cassiodorus. The greater part of people might have been unacquainted with them at the above-mentioned time; and there is no necessity for adhering so closely to the words of the epitaph, *nullus ante viderat*, as Maffei has done. Besides, Maffei himself destroys the foundation on which he rests his opinion; for he relates that a *horologium nocturnum* was sent to Pepin, king of France, by pope Stephen II. This appears from the pope's own letter; but Maffei is under a mistake respecting the name, for it was Paul, and not Stephen. The letter, which may be found in the *Codex Carolinus*,* is dated in the year 756. Maffei thinks that this machine was of a construction different from that of a water-clock; but if it pointed out the hours in the day-time, as well as in the night, according to his supposition, there is no reason, as Muratori observes, why it should have been called *horologium nocturnum*. In my opinion, we ought here to understand a clepsydra, or water-clock, such as that used by Cassiodorus for the like purpose, and which Hildemar recommended in the ninth century to the monks, who were obliged to observe the hours. Hildemar says, He who wishes to do this properly, must have *horologium aquæ*.*

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* Bouquet, Script. rer. Gall. et Franc. tom. v. p. 513.

"That these water-clocks however were then scarce, as well as in the following centuries, we have reason to conclude from their being so little spoken of in the writings of those periods. In the ancient customs of the monastery of St. Viton, at Werden,† written as is said in the tenth century, no mention of them occurs; and the monks regulated their prayers by the crowing of the cock; for it is said: *Cum lucem ales nunciaverit, dabuntur omnia signa in resurrectione Domini nostri*, &c. I find as little mention of them in the eleventh century, even in passages where they could not have been omitted, had they been known. Thus, in a little work, by Pet. Damiani, *De perfectione Monachorum*,* where the author speaks of the *significator horarum*, he does not so much as allude to a clepsydra. That the reader may know what he means by *significator horarum*, I shall here quote his own words: 'Non fabulis vacet, non longa cum aliquo misceat, non denique, quid a secularibus agatur, inquirat; sed commissæ sibi curæ semper intentus, semper providus, semperque sollicitus, volubilis sphæræ necessitatem, quiescere nescientem, siderum transitum, et elabentis temporis meditetur semper excursum. Porro psallendi sibi faceat consuetudinem, si discernendi horas quotidianam habere desiderat notionem; ut, quandocunque solis claritas, sive stellarum varietas nubium densitate non cernitur, illic in quantitate psalmodiæ, quam tenuerit, quoddam sibi velut horologium metiatur.'

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* Commentar. in Reg. S. Bened. cap. 8. See *Martene De ritib. eccl.* tom. iv. p. 5.

† Martene, tom. iv. p. 853.

"Some ascribe the invention of our modern clocks to Gerbert, who, in the tenth century, was raised to the pontifical chair at Rome, under the name of Sylvester II, and who was reckoned to be the first mathematician and astronomer of his time.† This opinion however is supported only by mere conjecture, and appears to be false from the account of Dithmar,* who says: 'Gerbertus, a finibus suis expulsus, Ottonen petiit imperatorem, et cum eo diu conversatus, in Magdaburg horologium fecit, illud recte constituens, considerata per fistulam quadam stella nautarum duce.' No mention is made here of wheels or weights, and this horologium seems to have been a sun-dial, which Gerbert fixed up by observing the pole-star. It appears, indeed, that Gerbert was acquainted with no other kind of *horologia*; for those who speak of his book *De Astrolabio*, in which he explains the method of constructing dials for various latitudes, produce no further proofs.† Some, according to the testimony of Kircher, consider this *horologium* to have been a portable dial, which showed the hour when properly set by the help of a needle touched with a magnet; but even this opinion is not warranted by the words of Dithmar.

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* Cap. 17.

† Journal des Sçavans 1734, p. 773. *Goujet, Etat des sciences dépuis la mort de Charlemagne, jusqu' à celle du Roi Robert.* Paris 1737, 8vo.

"The anonymous author of the Life of William, abbot of Hirshau,‡ who lived in the eleventh century, and who was a very learned man for his time, says: *naturale horologium ad exemplum cælestis hæmispherii excogitasse.* Though this passage is so short, that no idea can be formed from it of the construction of the machine, it is evident that it alludes neither to a sun-dial nor to a water-clock, but to some piece of mechanism which pointed out the hours and exhibited the motion of the earth and other planets. As more frequent mention of *horologia* occurs afterwards, and as, in speaking of them, expressions are used which cannot be applied to sun-dials or water-clocks, I am induced to think that the invention of our clocks belongs to this period. In the *Constitutiones Hirsaugienses*, or *Gengebacenses*, of the same William,* it is said of the sacristan, *eum horologium dirigere et ordinare.* In the like manner Bernardus Monachus, a writer of the same century, says, in the *Ordo Cluniacensis*,† 'apocrisiarium horologium dirigere et diligentius temperare.' The same author, in the Ancient Customs, &c. of the Monastery of St. Victor, at Paris, ‡ written also about the same time, says, that the registrar (*matricularius*), the sacrist's companion, ought 'horas canonicas nocte et die ad divinum celebrandum custodire, signa pulsare, *horologium temperare.*'

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* Chron. lib. vi. p. 83. edit. Francof. 1580. fol.

† Le Beuf, Rec. de div. écrits, &c. vol. ii. p. 89.

‡ Published by Car. Stengelius. Aug. Vind. 1611. p. 1.

"The unequal hours then in use rendered this regulating of the *horologia* necessary. The days and the nights consisted of twelve hours each; but sometimes shorter and sometimes longer. The reason of this is explained in the sixty-fourth chapter of the before-mentioned *Customs*, where it is

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* Lib. ii. cap. 34. Vet. disciplina monast. p. 520.

† Part. i. cap. 51. Ibid. p. 246.

‡ Cap. 23. ap. Martene De ant. rit. tom. iii. p. 739.

said: 'Ab æstivali solstitio usque ad solstitium hiemale sic horologium temperetur, quatenus illud noctis spatium, quod matutinas præcedat, per singulos menses secundum incrementa noctium aliquantulum crescat, donec paulatim crescendo tandem in hiemali solstitio spatium illud, quod est ante matutinas, ad illud quod sequitur, duplum fiat. Similiter per contrarium ab hiemali solstitio usque ad æstivale solstitium sic temperetur, quatenus spatium, quod præcedit, secundum noctium decrementum per singulos menses decrescat, donec paulatim decrescendo, tandem in solstitio æstivali spatium, quod est ante matutinas, et quod post sequitur, æquale fiat.' Such was the regulating of the *horologia*, and I much doubt whether it could be applied to water-clocks.

"These *horologia* not only pointed out the hours by an index, but emitted also a sound. This we learn from *Primaria Instituta Canonicorum Præmonstratensium*,* where it is ordered that the sacristan should regulate the *horologium* and make it sound before matins to awaken him. I dare not however venture thence to infer, that these machines announced the number of the hour by their sound, as they seem only to have given an alarm at the time of getting up from bed. I have indeed never yet found a passage where it is mentioned that the number of the hour was expressed by them; and when we read of their emitting a sound, we are to understand that it was for the purpose of wakening the sacristan to morning-prayers. The expression *horologium cecidit*, which occurs frequently in the before-quoted writers, I consider as allusive to this sounding of the machine.* Du Fresne, in my opinion, under the word *horologium*, conceives wrong the expression *de ponderibus in imum delapsis*, because the machine was then at rest, and could rouse neither the sacristan nor any one else whose business it was to beat the *scilla*.

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* Diss. ii. c. 8. ap. Martene *De ant. rit.* tom. iii. p. 989.

"I shall now produce other testimony which will serve further to confirm what I have here said of the origin of clocks. Calmet, in his Commentary on the *Regulæ S. Benedicti*,† quotes from a book on the usages of the Cistercians, three passages which I shall give as he has translated them, because I have not access at present to the original. 'On lit,' says he, 'au chap. 21 de la première partie de leurs Usages, compilez vers l'an 1120, qu'on ne fera sonner les cloches pour aucun exercice, pas même pour l'Horloge, dépuis la messe du Jeudi saint jusqu'à celle du Samedi saint; et au chap. 114, il est ordonné au sacristain de regler l'Horloge, en sorte qu'elle sonne, et qu'elle l'éveille pendant l'hyver avant matines, ou avant les nocturnes; et au chap. 68 et 114, que quand on s'est levé trop tôt, le sacristain avertît celui qui lit la dernière leçon, de la prolonger jusqu'à ce que l'Horloge sonne, ou qu'on fasse signe au lecteur de cesser.'

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* Wilhelm. Hirsaug. Consuet. lib. ii. c. 29. *Bernardus Monach. Ordo Clun.* pars i. c. 52. *Udalrici Mon. Consuetud. Clun.* lib. iii. c. 12. ap. *D'Archery*, tom. iv. ed. vet. tom. i. p. 693. ed nov.

† Tom. i. p. 280.

"The use of these machines must have been continued from that period, for we find them mentioned in the thirteenth century, in the commentary of Bernardus Cassinensis (Bernard of Cassino) on the unpublished *Regulæ S. Benedicti*, from the eighth chapter of which Martene* gives the following quotation: 'Facta autem jam hora octava, modicum erit amplius de media nocte quando surrexerit, *horologio excitante*, qui habet horologium custodire, et accensis lucernis ecclesiæ, quæ poterant propter prolixitatem noctis fuisse obscuratæ, ac pulsatis campanis ad dormientium fratrum excitationem, potuit transire dimidia octavæ horæ antequam surrexerint fratres.' It is said also in the *Chronicon Mellicense*,† in Du Fresne: 'Excitabit aliquis a superiore deputatus, qui *horologium excitatorium* habeat; ad omnes quoque cellas lumen deferat.'

"As all arts are at first imperfect, it is observed of these clocks that they sometimes deceived; and hence, in the *Ordo Cluniacensis Bernardi Mon.*[*] the person who regulated the clock is ordered, in case it should go wrong, 'ut notet in cereo, et in cursu stellarum vel etiam lunæ, ut fratres surgere faciat ad horam competentem.' The same admonition is given in the *Constitutiones Hirsaugienses.*[†]

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* Rit. ant. tom. iv. p. 5.

† Cap. 774.

"From what has been said I think it is sufficiently apparent that clocks moved by wheels and weights began certainly to be used in the monasteries in Europe, about the eleventh century. I do not, however, think that Europe is entitled to the honour of this invention; but that it is rather to be ascribed to the Saracens, to whom we are indebted for most of the mathematical sciences. This conjecture is supported by the *horologium* which, as Trithemius[‡] tells us, was sent by the sultan of Egypt, in the year 1232, to the emperor Frederic II. 'Eodem anno,' says he, 'Saladinus Egyptiorum Frederico imperatori dono misit per suos oratores tentorium pretiosum, mirabili arte compositum, cujus pretii æstimatio quinque ducatorum millium procul valorem excessit. Nam ad similitudinem sphærarum cælestium intrinsecus videbatur constructum, in quo imagines solis, lunæ, ac reliquorum planetarum artificiosissime compositæ movebantur ponderibus et rotis incitatæ; ita videlicet, quod, cursum suum certis ac debitis spatiis peragentes, horas tam noctis quam diei infallibili demonstratione designabant; imagines quoque xii signorum zodiaci certis distinctionibus suis motæ cum firmamento cursum in se planetarum continebant.'

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[*] P. 1. c. 51.

[†] Lib. ii. c. 34.

[‡] Chron. Hirsaug. ad. h. a.

"The writers of this century speak in such a manner of clocks that it appears they must, at that period, have been well known. Gulielmus Alvernus[*], disputing against those who deny the existence of the soul, after producing various arguments, thus obviates one which might be used against him. 'Nec te conturbant, inquit, motus, horologiorum, qui per aquam fiunt, et pondera, quæ quidem ad breve tempus et modicum fiunt, et indigent renovatione frequenti, et aptatione instrumentorum suorum, atque operatione forinsecus, astrologi videlicet qui peritiam habet hujus artificii. In corporibus vero animalium vel etiam vegetabilium totum intus est, intra ea scilicet, quod motus eorum atque partium suarum moderatur, et regit, ac modis omnibus perficit.' And Dante, the Italian poet, says:[†]

> E come cerchi in tempra d'orivoli
> Si giran, si che'l primo, a chi pon mente
> Quieto pare, e l'ultimo che voli, &c.

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[*] De anima, c. i. p. 7, 72.

[†] Parad. cant. xxiv. ver. 13.

"In the fourteenth century mention is made of the machine of Richard de Walingford, which has been hitherto considered as the oldest clock known. The description of it I shall give in the words of Leland:* 'Electus in monasterii præsidem—cum jam per amplas licebat fortunas, voluit illustri aliquo opere non modo ingenii, verum etiam eruditionis ac artis excellentis miraculum ostendere. Ergo talem horologii fabricam magno labore, majore sumtu, arte vero maxima compegit, qualem non habet tota, mea opinione, Europa secundam; sive quis cursum solis ac lunæ, seu fixa sidera notet, sive iterum maris incrementa et decrementa, seu lineas una cum figuris ac demonstrationibus ad infinitum pene variis consideret: cumque opus æternitate dignissimum ad umbilicum perduxisset, canones, ut erat in mathesi omnium sui temporis facile primus, edito in hoc libro scripsit, ne tam insignis machina errore monachorum vilesceret, aut incognito structuræ ordine sileret.' This machine, if I remember right, was called by the inventor Albion (all by one).

"Clocks hitherto had been, as it were, shut up in monasteries; but they now began to be employed for the common use and convenience of cities, though no instance of this is to be found before the above period. Hubert prince of Carrara caused the first clock ever publicly erected, to be put up at Padua, as we are told by Peter Paul Vergerius:[*] 'Horologium quo per diem et noctem quatuor et viginti horarum spatia sponte sua designarentur, in summa turri constituendum curavit.' It is said to have been made by James Dondi, whose family afterwards got the name of *Horologio*.[†] In remembrance of this circumstance the following verses were inscribed on his tombstone:

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* In Tanneri Biblioth. Brit. Hibern. p. 629.

> Quin procul excelsæ monitus de vertice turris
> Tempus, et instabiles numero quod colligis horas,
> Inventum cognosce meum, gratissime lector.

"John Dondi, son of the former, acquired no less fame by a clock which he constructed also, and which is thus described: 'In quo erat firmamentum,[‡] et omnium planetarum sphæræ, ut sic siderum omnium motus, veluti in cœlo, comprehendantur; festa edicta in dies monstrat, plurimaque alia oculis stupenda; tantaque fuit ejus horologii admiranda congeries, ut usque modo post ejus relictam lucem corrigere, et pondera convenientia assignare sciverit astrologus nemo. Verum de Francia nuper[§] astrologus et fabricator magnus, fama horologii tanti ductus, Papiam venit, plurimisque diebus in rotas congregandas elaboravit; tandemque actum est, ut in unum, eo quo decebat ordine, composuerit, motumque ut decet dederit.'

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[*] In Vit. princip. Carrar. ap. Murator. tom. xvi. p. 171.

[†] See Scardeonius de antiq. urbis Patavii, lib. ii. class. 9. p. 205. ed. Basil. 1560, fol. and the authors which he quotes.

[‡] These are the words of Mich. Savanarola in *Comm. de laud. Patav.* in *Muratori*, vol. xxiv. col. 1164.

[§] Sec. xiv.

"We are informed by the *Chronica miscella Bononiensis*,* that the first clock at Bologna was fixed up in the year 1356: 'A di 8 di Aprile fu tolta via la campana grossa della torre, ch'era nel palazzo di Messer Giovanni signor di Bologna, il qual palazzo dicevasi della Biada; e fu menata nella Corte del Capitano, e tirata e posta sulla Torre del Capitano nel Mercoledi Santo; e questo fu l' orologio, il quale fu il primo, che avesse mai il Comune di Bologna, e si commincio a sonare a di 19 di Maggio, il quale lo fece fare Messer Giovanni.

"Some time after the year 1364, Charles V, surnamed the Wise, king of France, caused a large clock to be placed in the tower of his palace, by Henry de Wyck,† whom he invited from Germany, because there was then at Paris no artist of that kind, and to whom he allowed a salary of six sols per day, with free lodging in the tower.

"Towards the end of the century, about the year 1370, Strasburgh also had a clock, a description of which is given by Conrad Dasypodius.[*]

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* In Muratori, tom. xviii. p. 444.

† Moreri, Diction. art. Horloge du Palais.

"Courtray, about the same period, was celebrated for its clock, which was carried away by the duke of Burgundy, in the year 1382. This circumstance is thus related by Froissard, a cotemporary writer:[†] 'Le duc de Bourgogne fit oster un horloge (qui sonnoit les heures), l'un des plus beaux qu'on seust trouver deçà ne delà la mer: et celui horloge fit tout mettre, par membres et pieces, sur chars, et la cloche aussi. Lequel horloge fut amené et charroyé en la ville de Digeon en Bourgogne: et fut là remis et assis: et y sonne les heures vingt-quatre, entre jour et nui.'

"We are told by Lehmann,[‡] that a public clock was put up at Spire in the year 1395. 'That year,' says he, 'the clock was erected on the Altburg gate. The bell for calling the people together to divine worship was cast by a bell-founder from Strasburgh.—The works of the clock cost fifty-one florins.'

"The greater part however of the principal cities of Europe were at this period without striking-clocks, which could not be procured but at a great expense. Of this we have an instance in the city of Auxerre. In the year 1483, the magistrates resolved to cause a clock to be constructed; but as it would cost a larger sum of money than they thought they had a right to dispose of by their own authority, they applied to Charles VIII, to request leave to employ a certain part of the public funds for that purpose.*

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[*] In the Account of the astronomical clock at Strasburgh, to be found in *Iac. von Königshovens Elsass und Strasb. Chronik.* p. 574.

[†] Vol. ii. c. 128. p. 229.

[‡] Lib. vii. c. 69, towards the end.

" The great clock in the church of the Virgin Mary at Nuremberg was erected, as we read, in the year 1462.†

" A public clock was put up at Venice in the year 1497.‡

" In the same century an excellent clock, which is described in a letter of Politian § to Francis Casa, in the year 1484, was constructed by one Lorenzo, a Florentine, for Cosmo I of Medici.

" Towards the end of this century, clocks began to be in use among private persons. This appears from a letter of Ambrosius Camaldulensis || to Ni-

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* Le Beuf, Mem. concernant l'hist. d'Auxerre, vol. ii. p. 342.

† Doppelmayer, p. 282.

‡ Thes. Ital. tom. iii. p. 3. p. 308.

§ Politiani Opera, Lugduni 1533, 8vo. p. 121.

|| Lib. xv. epist. 4.

colaus, a learned man of Florence: 'Horologium tuum mox, ut tuas accepi literas, paravi, misissemque, si fuisset præsto qui afferret. Ipsam mundari feci, nam erat pulvere obsitum, atque ideo, ne libere posset incedere, retardabatur. Et quia ne sic quidem recte currebat, Angelo illi illustri adolescenti harum rerum peritissimo dedi.'

"About this period also, mention is made of watches. Among the Italian poems of Gaspar Visconti, there is a sonnet with the following title: 'Si fanno certi orologii piccioli e portativi, che non poco di artificio sempre lavorano, mostrando le ore, e molti corsi de pianeti, e le feste, sonando quando il tempo lo ricerca. Questo sonetto è facto in persona de uno inamorato, che, guardando uno delli predicti orologii, compara se stesso a quello, &c.'*

"It appears, therefore, that Doppelmayer is mistaken when he says that watches were invented

by Peter Hele, at Nuremberg, in the sixteenth century; and that because they were shaped like an egg, they were called *Nuremberg animated eggs.*[*] I. Cocleus, in his *Description of Germany,*[†] speaking of this Hele, says: 'Eum juvenem adhuc admodum, opera efficere, quæ vel doctissimi admirentur mathematici. Nam ex ferro parva fabricat horologia plurimis digesta rotulis, quæ, quocunque vertantur, absque ullo pondere, et monstrant et pulsant xl horas, etiam si in sinu marsupiove contineantur.'"

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* This sonnet I shall here transcribe from *Antonii Saxii Hist. litterario-typographica Mediolan.* prefixed to *Philippi Argelati Biblioth. Scrip. Mediolanens.* i. p. 360.

Hò certa occulta forza in la secreta
  Parte del cor, qual sempre si lavora
  De sera a sera, e d'una a l'altra aurora,
  Che non spero la mente aver mai quieta.
Legger ben mi potria ogni discreta
  Vista nel fronte, ove amor colora
  D'affanno e di dolore il punto e l'ora,
  E la cagion, che riposar mi vieta.

L'umil squilletta sona il pio lamento,
  Che spesso mando al cielo, e la fortuna,
  Per disfogar cridando il fier tormento.
De le feste annual non ne mostro una,
  Ma pianeti iracondi, e di spavento,
  Eclipsati col sole, e con la luna.

Dominico Maria Manni, in his book *de Florentinis inventis,* chap. 29, calls the artist Lorenzo a Vulparia; and says that he was a native of Florence.

[*] Nachricht von den Nürnbergischen mathematicis und künstlern, Nurnberg 1730, fol. 289.

[†] Added to his *Comm. in Pomp. Melam.* cap. de Noriberga.

CLOCKS AND WATCHES.*

THE term *Horologia* occurs very early in different parts of Europe; but as this word, in old times, signified dials as well as clocks, nothing decisive can be inferred from it, unless it can be shown by concomitant circumstances or expressions, that it relates to a clock rather than a dial. Dante seems to be the first author who hath introduced the mention of an *orologio*, that struck the hour, and which consequently cannot be a dial, in the following lines:

> Indi come horologio che *ne chiami*,
> Nel hora che la sposa d'Idio surge,
> Amattinar lo sposo, perche l'ami.†

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Derham, in his *Artificial clock-maker*,† published

colaus, a learned man of Florence: 'Horologium tuum mox, ut tuas accepi literas, paravi, misissemque, si fuisset præsto qui afferret. Ipsam mundari feci, nam erat pulvere obsitum, atque ideo, ne libere posset incedere, retardabatur. Et quia ne sic quidem recte currebat, Angelo illi illustri adolescenti harum rerum peritissimo dedi.'

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"About this period also, mention is made of watches. Among the Italian poems of Gaspar Visconti, there is a sonnet with the following title: 'Si fanno certi orologii piccioli e portativi, che non poco di artificio sempre lavorano, mostrando le ore, e molti corsi de pianeti, e le feste, sonando quando il tempo lo ricerca. Questo sonetto è facto in persona de uno inamorato, che, guardando uno delli predicti orologii, compara se stesso a quello, &c.'*

"It appears, therefore, that Doppelmayer is mistaken when he says that watches were invented

by Peter Hele, at Nuremberg, in the sixteenth century; and that because they were shaped like an egg, they were called *Nuremberg animated eggs.*[*] I. Cocleus, in his *Description of Germany,*[†] speaking of this Hele, says: 'Eum juvenem adhuc admodum, opera efficere, quæ vel doctissimi admirentur mathematici. Nam ex ferro parva fabricat horologia plurimis digesta rotulis, quæ, quocunque vertantur, absque ullo pondere, et monstrant et pulsant xl horas, etiam si in sinu marsupiove contineantur.'"

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* This sonnet I shall here transcribe from *Antonii Saxii Hist. litterario-typographica Mediolan.* prefixed to *Philippi Argelati Biblioth. Scrip. Mediolanens.* i. p. 360.

Hò certa occulta forza in la secreta
  Parte del cor, qual sempre si lavora
  De sera a sera, e d'una a l'altra aurora,
  Che non spero la mente aver mai quieta.
Legger ben mi potria ogni discreta
  Vista nel fronte, ove amor colora
  D'affanno e di dolore il punto e l'ora,
  E la cagion, che riposar mi vieta.

L'umil squilletta sona il pio lamento,
  Che spesso mando al cielo, e la fortuna,
  Per disfogar cridando il fier tormento.
De le feste annual non ne mostro una,
  Ma pianeti iracondi, e di spavento,
  Eclipsati col sole, e con la luna.

Dominico Maria Manni, in his book *de Florentinis inventis,* chap. 29, calls the artist Lorenzo a Vulparia; and says that he was a native of Florence.

[*] Nachricht von den Nürnbergischen mathematicis und künstlern, Nurnberg 1730, fol. 289.

[†] Added to his *Comm. in Pomp. Melam.* cap. de Noriberga.

CLOCKS AND WATCHES.*

THE term *Horologia* occurs very early in different parts of Europe; but as this word, in old times, signified dials as well as clocks, nothing decisive can be inferred from it, unless it can be shown by concomitant circumstances or expressions, that it relates to a clock rather than a dial. Dante seems to be the first author who hath introduced the mention of an *orologio*, that struck the hour, and which consequently cannot be a dial, in the following lines:

Indi come horologio che *ne chiami*,
Nel hora che la sposa d'Idio surge,
Amattinar lo sposo, perche l'ami.†

Dante was born in 1265, and died in 1321, aged fifty-seven; striking-clocks therefore could not have been very uncommon in Italy, at the latter end of the thirteenth century or the beginning of the fourteenth.

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he might have done, whilst others contended that he might, and cited the case of Hengham, who was fined eight hundred marks for making an alteration in a record, by which a poor defendant was to pay only six shillings and eight-pence, instead of thirteen shillings and four-pence. Thus far the answer of the judges to the question was strictly proper; but the application of the fine to build a clock-house was not the least material;* besides, that it was probably a most notorious fact to every student, upon his first attending Westminster-hall, as we find judge Southcote, so much later, in the early part of queen Elizabeth's reign, not only mentioning the tradition, but that the clock still continued there, which had been furnished out of the Chief Justice's fine.† Sir Edward Coke likewise adds, that the eight hundred marks were actually entered on the roll, so that it is highly probable he had himself seen the record.‡

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But we have remaining to this day some degree of evidence, not only of the existence of such a

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† III Inst. 72.

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Zeller's conjecture that it was invented or first remarked in France, seems to me the more probable, as it appears that it was practised at Wurtemberg about the same period. In the year 1697 it was known there that some wine-merchants, particularly Hans George Staltser at Goppingen, used litharge of silver for refining wine, and by these means deprived many persons of life, and occasioned the loss of health to others. Staltser pleaded in excuse, that he considered the process he had employed as harmless, and that Masskosky, physician to the town of Goppingen, who was accounted a man of knowledge, had employed the same for his wine. Brugel also, physician to the town of Heidenheim, had declared that litharge was not prejudicial; and as he was a person of reputation, his opinion had tended not a little to establish the use of that practice. This report was so hurtful to the wine-trade of Wurtemberg, which at that time brought a great deal of money into the duchy from other countries, that the wine at Ulm remained unsold; and duke Everhard Louis was obliged to cause experiments to be made to ascertain the nature of the substances mixed with it. Solomon Keysel, the duke's physician, and J. Gaspar Harlin, physician to the court, both declared that litharge was noxious, but that sulphur besprinkled with bismuth was still more so. They strongly advised, therefore, that both these substances should be forbidden to be used, under the

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> Full sikerer was his crowing in his loge,
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By which, as I conceive at least, our old poet means to say, that the crowing was as certain as a *bell*, or abbey-*clock*.† For though we at present ask so

often, What is it *o'clock?* meaning the time-measurer; yet I should rather suppose, that in the fourteenth century the term *clock* was often applied to a *bell*, which was rung at certain periods, determined by an hour-glass or a sun-dial. Nor have I been able to stumble upon any passage which alludes to a clock, by that name, earlier than the thirteenth year of the reign of Henry VIII.* The abbey *orloge* (or clock) however must have been not uncommon when Chaucer wrote these lines; and from clocks beginning to be in use we might have had occasion for more artificers in this branch, though it should seem that we had Englishmen, who pretended at least to understand it, because the protection of Edward III, above cited, directs that the persons to whom it was granted, should not be molested whilst they were thus employed.

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> He'll watch the *horologe a double set*,
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I now pass on to a famous astronomical clock, made by one of our countrymen in the reign of

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By which the double set of twelve hours on a clock is plainly alluded to, as not many more than twelve can be observed on a dial; and in the same tragedy this last time-measurer is called by its proper name:

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> I will myself be your *orologere*
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colaus, a learned man of Florence: 'Horologium tuum mox, ut tuas accepi literas, paravi, misissemque, si fuisset præsto qui afferret. Ipsam mundari feci, nam erat pulvere obsitum, atque ideo, ne libere posset incedere, retardabatur. Et quia ne sic quidem recte currebat, Angelo illi illustri adolescenti harum rerum peritissimo dedi.'

"About this period also, mention is made of watches. Among the Italian poems of Gaspar Visconti, there is a sonnet with the following title: 'Si fanno certi orologii piccioli e portativi, che non poco di artificio sempre lavorano, mostrando le ore, e molti corsi de pianeti, e le feste, sonando quando il tempo lo ricerca. Questo sonetto è facto in persona de uno inamorato, che, guardando uno delli predicti orologii, compara se stesso a quello, &c.'*

"It appears, therefore, that Doppelmayer is mistaken when he says that watches were invented

by Peter Hele, at Nuremberg, in the sixteenth century; and that because they were shaped like an egg, they were called *Nuremberg animated eggs.* [*] I. Cocleus, in his *Description of Germany*,[†] speaking of this Hele, says: 'Eum juvenem adhuc admodum, opera efficere, quæ vel doctissimi admirentur mathematici. Nam ex ferro parva fabricat horologia plurimis digesta rotulis, quæ, quocunque vertantur, absque ullo pondere, et monstrant et pulsant xl horas, etiam si in sinu marsupiove contineantur.'"

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Hò certa occulta forza in la secreta
  Parte del cor, qual sempre si lavora
  De sera a sera, e d'una a l'altra aurora,
  Che non spero la mente aver mai quieta.
Legger ben mi potria ogni discreta
  Vista nel fronte, ove amor colora
  D'affanno e di dolore il punto e l'ora,
  E la cagion, che riposar mi vieta.

L'umil squilletta sona il pio lamento,
Che spesso mando al cielo, e la fortuna,
Per disfogar cridando il fier tormento.
De le feste annual non ne mostro una,
Ma pianeti iracondi, e di spavento,
Eclipsati col sole, e con la luna.

Dominico Maria Manni, in his book *de Florentinis inventis*, chap. 29, calls the artist Lorenzo a Vulparia; and says that he was a native of Florence.

[*] Nachricht von den Nürnbergischen mathematicis und künstlern, Nurnberg 1730, fol. 289.

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"We find, also, that Bernardus Saccus[*] ascribes the invention of clocks to Boethius, in the fifth century; but Bernardus seems to have forgotten what he quoted a little before from Cassiodorus,[†] respecting the clock of Boethius, that it determined the hours *guttis aquarum.* It must, therefore, have been a water-clock, and not a clock moved by wheels and weights. The same Cassiodorus[‡] had provided his monks at the monastery of St. Andiol,[§] in Languedoc, with machines of the like kind: 'Horologium vobis unum,' says he, 'quod solis claritas indicet, praeparasse cognoscor; alterum vero aquatile, quod die noctuque horarum iugiter indicat quantitatem; quia frequenter nonnullis diebus solis claritas abesse cognoscitur.' We are to understand, also, as alluding to such clocks, what is said by the writer of the life of St. Leobin, bishop of Chartrain, about the year 556,[||] when he tells us: ei (Leobino) temperandi cursus horarum et vigiliarum diligentiam commissam esse.

"I come now to the seventh century. In Du Fresne's *Lexicon mediæ et infimæ Latinitatis* we find

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[*] Hist. Ticin. lib. vii, c. 17.

[†] Var. lib. i. in fine.

[‡] De Institut. div. litter. c. 29.

[§] In the original, *Monasterium Vivariense.* TRANS.

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But the use of clocks was not confined to Italy at this period; for we had an artist in England about the same time, who furnished the famous clock-house near Westminster Hall, with a clock to be heard by the courts of law, out of a fine imposed on the Chief Justice of the King's Bench, in the sixteenth year of Edward I, or in 1288.* Blackstone in his Commentaries † has observed, that this punishment of Radulphus de Hengham is first taken notice of in the *Year Book*, ‡ during the reign of Richard III, where indeed no mention is made of a clock being thus paid for; but if the circumstances stated in the report of this case are considered, it was highly unnecessary, and perhaps improper, to have alluded to this application of the Chief Justice's fine.

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he might have done, whilst others contended that he might, and cited the case of Hengham, who was fined eight hundred marks for making an alteration in a record, by which a poor defendant was to pay only six shillings and eight-pence, instead of thirteen shillings and four-pence. Thus far the answer of the judges to the question was strictly proper; but the application of the fine to build a clock-house was not the least material;* besides, that it was probably a most notorious fact to every student, upon his first attending Westminster-hall, as we find judge Southcote, so much later, in the early part of queen Elizabeth's reign, not only mentioning the tradition, but that the clock still continued there, which had been furnished out of the Chief Justice's fine.† Sir Edward Coke likewise adds, that the eight hundred marks were actually entered on the roll, so that it is highly probable he had himself seen the record.‡

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sorte qu'elle sonne, et qu'elle l'éveille pendant l'hyver avant matines, ou avant les nocturnes; et au chap. 68 et 114, que quand on s'est levé trop tôt, le sacristain avertît celui qui lit la dernière leçon, de la prolonger jusqu'à ce que l'Horloge sonne, ou qu'on fasse signe au lecteur de cesser.'

"The use of these machines must have been continued from that period, for we find them mentioned in the thirteenth century, in the commentary of Bernardus Cassinensis (Bernard of Cassino) on the unpublished *Regulæ S. Benedicti*, from the eighth chapter of which Martene* gives the following quotation: 'Facta autem jam hora octava, modicum erit amplius de media nocte quando surrexerit, *horologio excitante*, qui habet horologium custodire, et accensis lucernis ecclesiæ, quæ poterant propter prolixitatem noctis fuisse obscuratæ, ac pulsatis campanis ad dormientium fratrum excitationem, potuit transire dimidia octavæ horæ antequam surrexerint fratres.' It is said also in the *Chronicon Mellicense*,† in Du Fresne: 'Excitabit aliquis a superiore deputatus, qui *horologium excitatorium* habeat; ad omnes quoque cellas lumen deferat.'

"As all arts are at first imperfect, it is observed of these clocks that they sometimes deceived; and

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* Rit. ant. tom. iv. p. 5.

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> As is a *clock*, or any abbey orloge.*

By which, as I conceive at least, our old poet means to say, that the crowing was as certain as a *bell*, or abbey-*clock*.† For though we at present ask so

scription of which is giveb by Conrad Dasypodius.[*]

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* Chaucer was born in 1328, and died in 1400.

† To the time of queen Elizabeth clocks were often called *orologes*:

> He'll watch the *horologe a double set*,
> If drink rock not his cradle.
>
> *Othello*, act ii. sc. 3.

"Courtray, about the same period, was celebrated for its clock, which was carried away by the duke of Burgundy, in the year 1382. This circumstance is thus related by Froissard, a cotemporary writer:[†] 'Le duc de Bourgogne fit oster un horloge (qui sonnoit les heures), l'un des plus beaux qu'on seust trouver deçà ne delà la mer: et celui horloge fit tout mettre, par membres et pieces, sur chars, et la cloche aussi. Lequel horloge fut amené et charroyé en la ville de Digeon en Bourgogne: et fut là remis et assis: et y sonne les heures vingt-quatre, entre jour et nui.'

"We are told by Lehmann,[‡] that a public clock was put up at Spire in the year 1395. 'That year,' says he, 'the clock was erected on the Altburg gate. The bell for calling the people together to divine worship was cast by a bell-founder from Strasburgh.—The works of the clock cost fifty-one florins.'

"The greater part however of the principal cities of Europe were at this period without striking-clocks, which could not be procured but at a great expense. Of this we have an instance in the city of Auxerre. In the year 1483, the magistrates resolved to cause a clock to be constructed; but as it would cost a larger sum of money than they thought they had a right to dispose of by their own authority, they applied to Charles VIII, to request leave to employ a certain part of the public funds for that purpose.*

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[*] In the Account of the astronomical clock at Strasburgh, to be found in *Iac. von Königshovens Elsass und Strasb. Chronik*. p. 574.

[†] Vol. ii. c. 128. p. 229.

[‡] Lib. vii. c. 69, towards the end.

" The great clock in the church of the Virgin Mary at Nuremberg was erected, as we read, in the year 1462.†

" A public clock was put up at Venice in the year 1497.‡

" In the same century an excellent clock, which is described in a letter of Politian § to Francis Casa, in the year 1484, was constructed by one Lorenzo, a Florentine, for Cosmo I of Medici.

" Towards the end of this century, clocks began to be in use among private persons. This appears from a letter of Ambrosius Camaldulensis || to Ni-

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* Le Beuf, Mem. concernant l'hist. d'Auxerre, vol. ii. p. 342.

† Doppelmayer, p. 282.

‡ Thes. Ital. tom. iii. p. 3. p. 308.

§ Politiani Opera, Lugduni 1533, 8vo. p. 121.

|| Lib. xv. epist. 4.

colaus, a learned man of Florence: 'Horologium tuum mox, ut tuas accepi literas, paravi, misissemque, si fuisset præsto qui afferret. Ipsam mundari feci, nam erat pulvere obsitum, atque ideo, ne libere posset incedere, retardabatur. Et quia ne sic quidem recte currebat, Angelo illi illustri adolescenti harum rerum peritissimo dedi.'

"About this period also, mention is made of watches. Among the Italian poems of Gaspar Visconti, there is a sonnet with the following title: 'Si fanno certi orologii piccioli e portativi, che non poco di artificio sempre lavorano, mostrando le ore, e molti corsi de pianeti, e le feste, sonando quando il tempo lo ricerca. Questo sonetto è facto in persona de uno inamorato, che, guardando uno delli predicti orologii, compara se stesso a quello, &c.'*

"It appears, therefore, that Doppelmayer is mistaken when he says that watches were invented

by Peter Hele, at Nuremberg, in the sixteenth century; and that because they were shaped like an egg, they were called *Nuremberg animated eggs.*[*] I. Cocleus, in his *Description of Germany,*[†] speaking of this Hele, says: 'Eum juvenem adhuc admodum, opera efficere, quæ vel doctissimi admirentur mathematici. Nam ex ferro parva fabricat horologia plurimis digesta rotulis, quæ, quocunque vertantur, absque ullo pondere, et monstrant et pulsant xl horas, etiam si in sinu marsupiove contineantur.'"

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Hò certa occulta forza in la secreta
  Parte del cor, qual sempre si lavora
  De sera a sera, e d'una a l'altra aurora,
  Che non spero la mente aver mai quieta.
Legger ben mi potria ogni discreta
  Vista nel fronte, ove amor colora
  D'affanno e di dolore il punto e l'ora,
  E la cagion, che riposar mi vieta.

L'umil squilletta sona il pio lamento,
  Che spesso mando al cielo, e la fortuna,
  Per disfogar cridando il fier tormento.
De le feste annual non ne mostro una,
  Ma pianeti iracondi, e di spavento,
  Eclipsati col sole, e con la luna.

Dominico Maria Manni, in his book *de Florentinis inventis,* chap. 29, calls the artist Lorenzo a Vulparia; and says that he was a native of Florence.

[*] Nachricht von den Nürnbergischen mathematicis und künstlern, Nurnberg 1730, fol. 289.

[†] Added to his *Comm. in Pomp. Melam.* cap. de Noriberga.

CLOCKS AND WATCHES.[*]

The term *Horologia* occurs very early in different parts of Europe; but as this word, in old times, signified dials as well as clocks, nothing decisive can be inferred from it, unless it can be shown by concomitant circumstances or expressions, that it relates to a clock rather than a dial. Dante seems to be the first author who hath introduced the mention of an *orologio*, that struck the hour, and which consequently cannot be a dial, in the following lines:

> Indi come horologio che *ne chiami*,
> Nel hora che la sposa d'Idio surge,
> Amattinar lo sposo, perche l'ami.[†]

Dante was born in 1265, and died in 1321, aged fifty-seven; striking-clocks therefore could not have been very uncommon in Italy, at the latter end of the thirteenth century or the beginning of the fourteenth.

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[*] This article, written by the Hon. Daines Barrington, was translated by professor Beckman, from the *Archæologia*, vol. v. p. 416. It is here given from the original almost verbatim, with the addition of professor Beckman's notes, translated from the German, which are distinguished by the initials of his name. Trans.

[†] Dante, Paradiso, c. x.

But the use of clocks was not confined to Italy at this period; for we had an artist in England about the same time, who furnished the famous clock-house near Westminster Hall, with a clock to be heard by the courts of law, out of a fine imposed on the Chief Justice of the King's Bench, in the sixteenth year of Edward I, or in 1288.* Blackstone in his Commentaries† has observed, that this punishment of Radulphus de Hengham is first taken notice of in the *Year Book*,‡ during the reign of Richard III, where indeed no mention is made of a clock being thus paid for; but if the circumstances stated in the report of this case are considered, it was highly unnecessary, and perhaps improper, to have alluded to this application of the Chief Justice's fine.

It appears by the *Year Book*, that Richard III had closeted the judges in the *Inner* Star Chamber, to take their opinions upon three points of law; the second of which was, "Whether a justice of the peace, who had inrolled an indictment, which had been negatived by the grand-jury, amongst the *true bills*, might be punished for this abuse of his office." On this question a diversity of opinion arose amongst the judges, some of whom supposed that a magistrate could not be prosecuted for what

he might have done, whilst others contended that he might, and cited the case of Hengham, who was fined eight hundred marks for making an alteration in a record, by which a poor defendant was to pay only six shillings and eight-pence, instead of thirteen shillings and four-pence. Thus far the answer of the judges to the question was strictly proper; but the application of the fine to build a clock-house was not the least material;* besides, that it was probably a most notorious fact to every student, upon his first attending Westminster-hall, as we find judge Southcote, so much later, in the early part of queen Elizabeth's reign, not only mentioning the tradition, but that the clock still continued there, which had been furnished out of the Chief Justice's fine.† Sir Edward Coke likewise adds, that the eight hundred marks were actually entered on the roll, so that it is highly probable he had himself seen the record.‡

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† Vol. iii. p. 408.

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But we have remaining to this day some degree of evidence, not only of the existence of such a

clock, but that it is of the antiquity already ascribed to it, viz. the reign of Edward I. On the side of New Palace-yard, which is opposite to Westminster-hall, and in the second pediment of the new buildings from the Thames, a dial is inserted with this remarkable motto upon it, *Discite justitiam moniti*, which seems most clearly to relate to the fine imposed on Radulphus de Hengham being applied to the paying for a clock. But it may be said that this inscription is on a dial and not upon a clock; which, though it appears upon the first stating it to be a most material objection, yet I conceive it may receive the following satisfactory answer. The original clock of Edward the First's reign was probably a very indifferent one, but from its great antiquity, and the tradition attending it, was still permitted to remain till the time of queen Elizabeth, according to the authorities already cited. After this, being quite decayed, a dial might have been substituted and placed upon the same clock-house, borrowing its very singular motto; which, whether originally applied in the time of Edward I, or in later reigns, most plainly alludes to Hengham's punishment for altering a record. It should also be mentioned, that this dial seems to have been placed exactly where the clock-house stood according to Strype.*

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I shall now produce a proof, that not only clocks but watches were made in the beginning of the fourteenth century. Seven or eight years ago, some labourers were employed at Bruce Castle, in Fifeshire, where they found a watch, together with some coin, both of which they disposed of to a shopkeeper of St. Andrews, who sent the watch to his brother in London, considering it as a curious piece of antiquity.[†] The outer case is silver, raised, in rather a handsome pattern, over a ground of blue enamel; and I think I can distinguish a cypher of R. B. at each corner of the enchased work. On the dial-plate is written, *Robertus B. Rex Scotorum*, and over it is a convex transparent horn, instead of the glasses which we use at present. Now *Robertus B. Rex Scotorum* can be no other king of Scotland than Robert Bruce, who began his reign in 1305, and died in 1328; for the Christian name of Baliol, who succeeded him, was Edward; nor can *Robertus B.* be applied to any later Scottish king. This very singular watch is not of a

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often, What is it *o'clock?* meaning the time-measurer; yet I should rather suppose, that in the fourteenth century the term *clock* was often applied to a *bell*, which was rung at certain periods, determined by an hour-glass or a sun-dial. Nor have I been able to stumble upon any passage which alludes to a clock, by that name, earlier than the thirteenth year of the reign of Henry VIII.* The abbey *orloge* (or clock) however must have been not uncommon when Chaucer wrote these lines; and from clocks beginning to be in use we might have had occasion for more artificers in this branch, though it should seem that we had Englishmen, who pretended at least to understand it, because the protection of Edward III, above cited, directs that the persons to whom it was granted, should not be molested whilst they were thus employed.

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He'll watch the *horologe a double set*,
If drink rock not his cradle.
Othello, act ii. sc. 3.

I now pass on to a famous astronomical clock, made by one of our countrymen in the reign of

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By which the double set of twelve hours on a clock is plainly alluded to, as not many more than twelve can be observed on a dial; and in the same tragedy this last time-measurer is called by its proper name:

> More tedious than the dial eight score times.
>
> *Ibid.* act iii. sc. 4.

The clock of Wells cathedral is also, to this day, called the *horologe*.

[*] See *Dugdale's Origines Jurid.* Lydgate, therefore, who wrote before the time of Henry VIII, says:

> I will myself be your *orologere*
> To-morrow early.
>
> *Prologue to the Storye of Thebes.*

Richard II, the account of which I have extracted from Leland. Richard of Walingford was son of a smith, who lived at that town, and who, from his learning and ingenuity, became abbot of St. Alban's. Leland, speaking of him, says: 'Cum jam per amplas licebat fortunas, voluit illustri aliquo opere, non modo ingenii, verum etiam eruditionis, ac artis excellentis, miraculum ostendere. Ergo talem *horologii* fabricam magno labore, majore sumtu, arte vero maxima, compegit, qualem non habet tota Europa, *mea opinione*, secundam, sive quis cursum solis ac lunæ, seu fixa sidera notet, sive iterum maris incrementa et decrementa.'[*] Richard of Walingford wrote also a treatise on this clock, 'ne tam insignis machina vilesceret errore monachorum, aut incognito structurae ordine silesceret.' From what hath been above stated, it appears that this astronomical clock continued to go in Leland's time, who was born at the latter end of Henry the Seventh's reign, and who speaks of a tradition, that this famous piece of mechanism was called *Albion* by the inventor.

Having thus endeavoured to prove that clocks were made in England from the time of Edward I to that of Richard II; it is not essential to my principal purpose to deduce them lower through the successive reigns; but when I have shortly

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[*] Leland de Script. Brit.

colaus, a learned man of Florence: 'Horologium tuum mox, ut tuas accepi literas, paravi, misissemque, si fuisset præsto qui afferret. Ipsam mundari feci, nam erat pulvere obsitum, atque ideo, ne libere posset incedere, retardabatur. Et quia ne sic quidem recte currebat, Angelo illi illustri adolescenti harum rerum peritissimo dedi.'

"About this period also, mention is made of watches. Among the Italian poems of Gaspar Visconti, there is a sonnet with the following title: 'Si fanno certi orologii piccioli e portativi, che non poco di artificio sempre lavorano, mostrando le ore, e molti corsi de pianeti, e le feste, sonando quando il tempo lo ricerca. Questo sonetto è facto in persona de uno inamorato, che, guardando uno delli predicti orologii, compara se stesso a quello, &c.'*

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in 1714, mentions a watch of Henry VIII which was still in order; and Dr. Demainbray informs me, that he hath heard both Sir Isaac Newton and Demoivre speak of this watch.* The emperor Charles V, Henry's cotemporary, was so much pleased with these time-measurers, that he used to sit after his dinner with several of them on the table, his bottle being in the centre; † and when he retired to the Monastery of St. Just, he continued still to amuse himself with keeping them in order, which is said to have produced a reflection from him on the absurdity of his attempt to regulate the motions of the different powers of Europe.

Some of the watches used at this time, seem to have been strikers; at least we find in the *Memoirs of Literature*, that such watches having been stolen both from Charles V and Lewis XI whilst they were in a crowd, the thief was detected by their striking the hour. ‡ In most of the more ancient watches, of which I have seen several in the collection of Sir Ashton Lever and Mr. Ingham Forster,

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* That distinguished antiquary Mr. Walpole has in his possession a clock, which appears by the inscription to have been a present from Henry VIII to Anne Boleyn. Poynet, bishop of Winchester, likewise gave an astronomical clock to the same king. *Godwyn de Præsul.*

† Mémoires de Litt. vol. xx. See also the lately published *Collection of State Papers*, vol. i. p. 53.

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But the use of clocks was not confined to Italy at this period; for we had an artist in England about the same time, who furnished the famous clock-house near Westminster Hall, with a clock to be heard by the courts of law, out of a fine imposed on the Chief Justice of the King's Bench, in the sixteenth year of Edward I, or in 1288.* Blackstone in his Commentaries† has observed, that this punishment of Radulphus de Hengham is first taken notice of in the *Year Book*,‡ during the reign of Richard III, where indeed no mention is made of a clock being thus paid for; but if the circumstances stated in the report of this case are considered, it was highly unnecessary, and perhaps improper, to have alluded to this application of the Chief Justice's fine.

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often, What is it *o'clock?* meaning the time-measurer; yet I should rather suppose, that in the fourteenth century the term *clock* was often applied to a *bell*, which was rung at certain periods, determined by an hour-glass or a sun-dial. Nor have I been able to stumble upon any passage which alludes to a clock, by that name, earlier than the thirteenth year of the reign of Henry VIII.* The abbey *orloge* (or clock) however must have been not uncommon when Chaucer wrote these lines; and from clocks beginning to be in use we might have had occasion for more artificers in this branch, though it should seem that we had Englishmen, who pretended at least to understand it, because the protection of Edward III, above cited, directs that the persons to whom it was granted, should not be molested whilst they were thus employed.

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* Chaucer was born in 1328, and died in 1400.

† To the time of queen Elizabeth clocks were often called *orologes*:

> He'll watch the *horologe a double set*,
> If drink rock not his cradle.
> *Othello*, act ii. sc. 3.

I now pass on to a famous astronomical clock, made by one of our countrymen in the reign of

---

By which the double set of twelve hours on a clock is plainly alluded to, as not many more than twelve can be observed on a dial; and in the same tragedy this last time-measurer is called by its proper name:

More tedious than the dial eight score times.

Ibid. act iii. sc. 4.

The clock of Wells cathedral is also, to this day, called the *horologe*.

* See *Dugdale's Origines Jurid.* Lydgate, therefore, who wrote before the time of Henry VIII, says:

I will myself be your *orologere*
To-morrow early.

Prologue to the Storye of Thebes.

Richard II, the account of which I have extracted from Leland. Richard of Walingford was son of a smith, who lived at that town, and who, from his learning and ingenuity, became abbot of St. Alban's. Leland, speaking of him, says: 'Cum jam per amplas licebat fortunas, voluit illustri aliquo opere, non modo ingenii, verum etiam eruditionis, ac artis excellentis, miraculum ostendere. Ergo talem *horologii* fabricam magno labore, majore sumtu, arte vero maxima, compegit, qualem non habet tota Europa, *mea opinione*, secundam, sive quis cursum solis ac lunæ, seu fixa sidera notet, sive iterum maris incrementa et decrementa.'* Richard of Walingford wrote also a treatise on this clock, 'ne tam insignis machina vilesceret errore monachorum, aut incognito structurae ordine silesceret.' From what hath been above stated, it appears that this astronomical clock continued to go in Leland's time, who was born at the latter end of Henry the Seventh's reign, and who speaks of a tradition, that this famous piece of mechanism was called *Albion* by the inventor.

Having thus endeavoured to prove that clocks were made in England from the time of Edward I to that of Richard II; it is not essential to my principal purpose to deduce them lower through the successive reigns; but when I have shortly

stated what I happen to have found with regard to this useful invention in other parts of Europe, I shall attempt to show why they were not more common in the thirteenth and fourteenth centuries.

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* Leland de Script. Brit.

The citation from Dante, which I have before relied upon, shows, that they were not unknown in Italy during that period; and Mr. Falconet, in *Mémoires de Litterature*, informs us, that a James Dondi, in the fourteenth century, assumed from a clock made by him for the tower of a palace, the name of *Horologius*, which was afterwards borne by his descendants.

In France, or what is now so called, Froissart mentions, that during the year 1332, Philip the Hardy, duke of Burgundy, removed from Courtray to his capital at Dijon a famous clock which struck the hours, and was remarkable for its mechanism.* The great clock at Paris was put up in the year 1370, during the reign of Charles V, having been made by Charles de Wic,† a German. Carpentier, in his supplement to Du Cange, cites a decision of the parliament of Paris in the year 1413, in which Henry Bye, one of the parties, is styled *Gubernator Horologii palatii nostri Parisiis.*‡

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* Froissart, vol. ii. ch. 127.

† Falconet, Mémoires de Litt. vol. xx.

‡ See Carpentier, art. *Horologiator*.

About the same time also the clock at Montargis was made, with the following inscription:

> Charles le Quint (sc. de France)
> Me fit par Jean de *Jouvence*.

The last word seems to be the name of a Frenchman.

Though I have not happened to meet with any mention of very early clocks in Germany, yet from the great clock at Paris in 1370 being the work of De Wic, as also from the protection granted by Edward III to three clock-makers from Delft, it should seem that this part of Europe[*] was not without this useful invention; and the same may be inferred with regard to Spain from the old saying: *Estar como un relox.*[*]

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[*] Mr. Peckett, an ingenious apothecary of Compton Street, Soho, hath shown me an astronomical clock which belonged to the late Mr. Ferguson, and which still continues to go. The workmanship on the outside is elegant, and it appears to have been made by a German in 1525, by the subjoined inscription in the Bohemian of the time:

> *Iar. da. macht. mich. Iacob. Zech.*
> *Zu. Prag. ist. bar. da. man. zalt.* 1525.

The above Englished:

> Year. when. made. me. Jacob. Zech.
> At. Prague. is. true. when. counted. 1525.

The diameter of the clock is nine inches three fourths, and the height five inches.

[I have transposed the words, as I find them in the original; but *war* seems to have stood in the place of *bar*, at least Barrington has translated it by *is true*, and we must read:

> *Da man zält* 1525 *jar*
> *Da macht mich Iacob Zech zu Prag ist wahr.*—I. B.]

Having now produced instances of several clocks, and even a watch, which were made in different parts of the fourteenth century, as also having endeavoured to prove that they were not excessively uncommon even in the thirteenth, it may be thought necessary that I should account for their not being more generally used during those periods, as, in their present state at least, they are so very convenient. For this it should seem that many reasons may be assigned.

In the infancy of this new piece of mechanism, they were probably of a very imperfect construction, perhaps never went tolerably, and were soon deranged, whilst there was no one within a reasonable distance to put them in order. To this day the most musical people have seldom a harpsichord in their house, if the tuner cannot be procured from the neighbourhood. We find therefore that Henry VI of England, and Charles V of France, appointed clock-makers, with a stipend, to keep the Westminster and Paris clocks in order.

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[*] I am also referred by the Rev. Mr. Bowle, F. S. A. to the following passage in the *Abridged History of Spain*, vol. i. p. 568: "The first clock seen in Spain was set up in the cathedral of Seville, 1400."

It need scarcely be observed also, that, as the artists were so few, their work must have been charged accordingly, and that kings only could be the purchasers of what was rather an expensive toy, than of any considerable use. And it may perhaps be said, that they continued in a great measure to be no better than toys, till the middle of the seventeenth century. Add to this, that in the thirteenth and fourteenth centuries, there was so little commerce, intercourse, or society, that an hour-glass, or the sun, was very sufficient for the common purposes, which are now more accurately settled by clocks of modern construction. Dials and hour-glasses likewise wanted no mending.

Having now finished what hath occurred to me with regard to the first introduction of clocks, I shall conclude by a few particulars, which I have been enabled to pick up, in relation to those more portable measurers of time, called *watches*, the earliest of which, except that of Robert Bruce, king of Scotland, seems to be one in Sir Ashton Lever's most valuable museum, the date upon which is 1541.*

Derham, in his *Artificial clock-maker*,† published in 1714, mentions a watch of Henry VIII which was still in order; and Dr. Demainbray informs me, that he hath heard both Sir Isaac Newton and Demoivre speak of this watch.[*] The emperor Charles V, Henry's cotemporary, was so much pleased with these time-measurers, that he used to sit after his dinner with several of them on the table, his bottle being in the centre;[†] and when he retired to the Monastery of St. Just, he continued still to amuse himself with keeping them in order, which is said to have produced a reflection from him on the absurdity of his attempt to regulate the motions of the different powers of Europe.

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* The oldest clock we have in England that is supposed to go tolerably, is of the preceding year, viz. 1540, the initial letters of the maker's name being *N. O.* It is in the palace at Hampton Court. *Derham's Artificial clock-maker.*

† A German translation of this book is added to *Welper's Gnomick.* I. B.

Some of the watches used at this time, seem to have been strikers; at least we find in the *Memoirs of Literature*, that such watches having been stolen both from Charles V and Lewis XI whilst they were in a crowd, the thief was detected by their striking the hour.[‡] In most of the more ancient watches, of which I have seen several in the collection of Sir Ashton Lever and Mr. Ingham Forster, catgut supplied the place of a chain,* whilst they were commonly of a smaller size than we use at present, and often of an oval form.†

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[*] That distinguished antiquary Mr. Walpole has in his possession a clock, which appears by the inscription to have been a present from Henry VIII to Anne Boleyn. Poynet, bishop of Winchester, likewise gave an astronomical clock to the same king. *Godwyn de Præsul.*

[†] Mémoires de Litt. vol. xx. See also the lately published *Collection of State Papers*, vol. i. p. 53.

[‡] Vol. xx.

From these and probably many other imperfections, they were not in any degree of general request, till the latter end of queen Elizabeth's reign. Accordingly in Shakespeare's Twelfth Night Malvolio says: "I frown the while, and perchance *wind up my watch*, or play with some rich jewel." Again, in the first edition of Harrington's *Orlando Furioso*, printed in 1591, the author is represented with what seems to be a watch, though the engraving is by no means distinct, on which is written *Il tempo passa.*‡

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* A clockmaker of this city (Gottingen) assured me that several watches which had catgut instead of a chain, were brought to him to be repaired. *I. B.*

† Barrington says here, in a note, "Pancirollus informs us, that about the end of the fifteenth century watches were made no larger than an almond, by a man whose name was Mermecide. *Encyclop.*" The first part of this assertion is to be found, indeed, in Pancirollus, edition of Franckfort 1646, 4to. ii. p. 168; but Myrmecides was an ancient Greek artist, whose παραναλωματα, or uncommonly small pieces of mechanism, are spoken of by Cicero and Pliny. He is not mentioned by Pancirollus, but by Salmuth, p. 231. It is probable that this error may be in the *Encyclopédie*; at least Barrington refers to it, as his authority. I. B.

‡ Somner's Canterbury, Supplement, no. xiv. p. 36. See also, in an extract from archbishop Parker's will, made April 5th 1575: Do et lego fratri meo Ricardo episcopo Eliensi baculum meum de canna Indica, qui *horologium* habet in summitate. As likewise in the brief of his goods, &c. no. xiv. p. 39, A clock valued at 54*l.* 4*s.*

In the third year of James I. a watch was found upon Guy Fawkes, which he and Percy had bought the day before, "to try conclusions for the long and short burning of the touchwood, with which he had prepared to give fire to the train of powder." *

In 1631, Charles I incorporated the clock-makers; and the charter prohibits *clocks*, *watches*, and *alarms*, from being imported; which sufficiently proves that they were now more commonly used, as well as that we had artists of our own who were expert in this branch of business.

About the middle of the seventeenth century, Huygens made his great improvement in clock-work, which produced many others from our own countrymen; † the latest of which was the introduction of repeating-watches, in the time of Charles II, who, as I have been informed by the late lord Bathurst, sent one of the first of these new inventions to Lewis XIV. The former of these kings was very curious with regard to these time-measurers; and I have been told by an old person of the trade, that watchmakers, particularly East, used to attend whilst he was playing at the Mall; a watch being often the stake.

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* Stow's Chron. p. 878; and Introduct. to Mr. Reuben Burrow's Almanac for 1778.

† More particularly Dr. Hook, Tompion, &c.

But we have a much more curious anecdote of royal attention to watches in Dr. Derham's *Artificial clock-maker*.[*] Barlow had procured a patent, in concert with the Lord Chief Justice Allebone, for *repeaters*; but Quare making one at the same time upon ideas he had entertained before the patent was granted, James II tried both, and giving the preference to Quare's, it was notified in the gazette. In the succeeding reign, the reputation of the English work in this branch was such, that in the year 1698, an act passed, obliging the makers to put their names on watches, lest discreditable ones might be sold abroad for English.[†]

Letter on the pretended Watch of King Robert Bruce.[‡]

You will remember that I formerly mentioned something to you in reference to the observations

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[*] Derham's Artificial clock-maker, p. 107.

[†] The Ninth and Tenth of William III. ch. 28. s. 2.

[‡] This letter, signed John Jamieson, and dated Forfar, August 20th, 1785, was translated into German from the *Gentleman's Magazine* for the before-mentioned year, vol. ii. p. 688. It is here given verbatim from that publication, as the original must undoubtedly be preferable to a translation from a translation. The two notes, with the signature B, are by Professor Beckman. TRANS.

One of my literary friends in London, to whom I am indebted for much learned information, says, in a letter which I received from him: "I had never believed the story of Robert Bruce's watch, mentioned in your translation of Barrington's History of clocks, the more as Mr.

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hand. He fixed a time for showing me this invaluable curiosity; but even then it could not be seen. My avidity produced many anxious calls, although by that time I began to suspect he meant to play upon me, especially as I did not think it altogether credible that Mrs. Bruce would sell such a relique of her family if she had ever had it in her possession. At length I was favoured with a sight of it. The watch, as far as I can recollect, almost entirely answered the one described. It had a ground of blue enamel. It had a horn above the dial-plate instead of a glass. The inscription was on the plate. But whether it was *Robertus B.* or *Robertus Bruce,* I cannot remember. The watch was very small and neat, and ran only, to the best of my knowledge, little more than twelve hours, at least not a complete day. The Hon. Mr. Barrington does not mention any thing about this circumstance. It is about twelve years since I saw it. Whether there be any castle in Fife, properly called Bruce castle, I know not; but the castle of Clackmannan hath always been the residence of the eldest branch of the family; and although the town in which it stands now gives name to a small county, yet in former times, and still in common language, that whole district receives the name of Fife, as distinguishing it from the county on the other side the firths of Forth and Tay. The first thing that occurred to me about the watch itself, was in regard to the inscription.

Observing that all the coins of king Robert's age bore Saxon characters, I could not believe the inscription to be genuine, because the characters were not properly Saxon, but a kind of rugged Roman, or rather Italic characters, like those commonly engraved, but evidently done very coarsely, to favour the imposition. He valued it at 1 *l.* 10*s.* but I would have nothing to do with it. The first time I had an opportunity of seeing Mrs. Bruce of Clackmannan, after this, I asked her if such a watch had ever been found. She told me that she never so much as heard of any such thing. This confirmed the justness of my suspicion.

I paid no further regard to this story till about seven years ago, when I received a letter from a friend, informing me, that a brother of his in London, who had a taste for antiquity, had desired him, if possible, to procure some intelligence from Glasgow about a watch, said to be king Robert Bruce's, which had thence found its way to London, and was there making a great noise among the antiquaries. I then applied to my former goldsmith, who was then in a more respectable way, and mentioned the old story. He immediately fell a-laughing, and told me, that he did it merely for a piece of diversion, and thought the story would take with me, as I had been often asking about the place. He said that it was an old watch brought from America; that, to get some sport with my credulity, he had engraved the inscription upon it in a rough, antiquated-like form; that he had afterwards sold it for two guineas; he had learned that it was next sold for five, and had never more heard of it.

However early the invention of clocks might be, I am greatly mistaken if any authentic documents can be produced of the art of making pocket-watches being discovered so early as the beginning of the fourteenth century. Lord Kaimes, somewhere in his *Sketches of Man*, asserts, that the first watch was made in Germany, so far as I can remember, near the close of the fifteenth.* If any watch had been made so early as R. Bruce's time, it is most likely the inscription would have been in Saxon characters, as not only the money both of Scotland and England but of Germany, in that age, bears a character either Saxon, or greatly resembling it.

If Mr. Urban thinks these observations worthy a place in his valuable magazine, they can in that channel be communicated to the public, and submitted to the attention of those who may have an opportunity of examining the affair in question

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* The passage may be found, vol. i. p 95. of the edition in quarto, Edinburgh 1774: "Pocket-watches were brought there from Germany, an. 1577." Home, or Lord Kaimes, however, was too celebrated or too artful a writer to produce proofs of his historical assertions. B.

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